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AND MANAGEMENT

The National Telephone Magazine

DECEMBER 15, 1941 New Priority Form Issued ... Trial Comparative Cost Studies ... Wire Chief's Training Course ... Davies Reports on War Conditions ... Line & Desk ... Data Sheets

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TELEPHONE ENGINEER

MANAGEMENT · ENGINEERING · MAINTENANCE

"THE NATIONAL TELEPHONE MAGAZINE"
FOUNDED 1909

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1941

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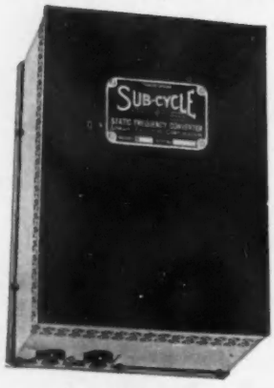

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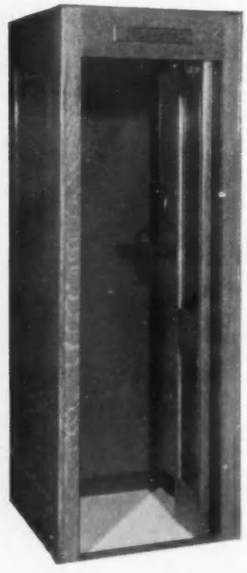

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ACROSS THE Editor's Desk

When so many of us are deep in despair because of our precipitation into the war it is a real pleasure for the writer to hear that our and your friend Murray W. Redmond, Supply Manager of the Stromberg-Carlson company, is now home and convalescing from a very serious major operation that hospitalized him for many weeks. Murray was quite ill for a time but is now definitely on the mend—and better still—home for Christmas.

▲

It has been my pleasure to use this column on December 15 of each year for a short Christmas message to personal and business friends in the telephone industry. This year, for some peculiar reason, the words do not come as easy as they have on past Christmases. Being embroiled in world conflict has quite a sobering effect on exuberant Christmas spirit as we know it. Still, we can be indeed thankful of our national unity that now is as universal as our thoughts on Christmas morning when those two magic words of "Merry Christmas" are on our lips for every one.

▲

On behalf of our Staff, I do want to wish our subscribers and advertisers the Happiest of the Yuletide Season. 1941 has been a year of many changes and growth for TELEPHONE ENGINEER. We are thankful!

Ray

WHEN IT COMES TO POLES
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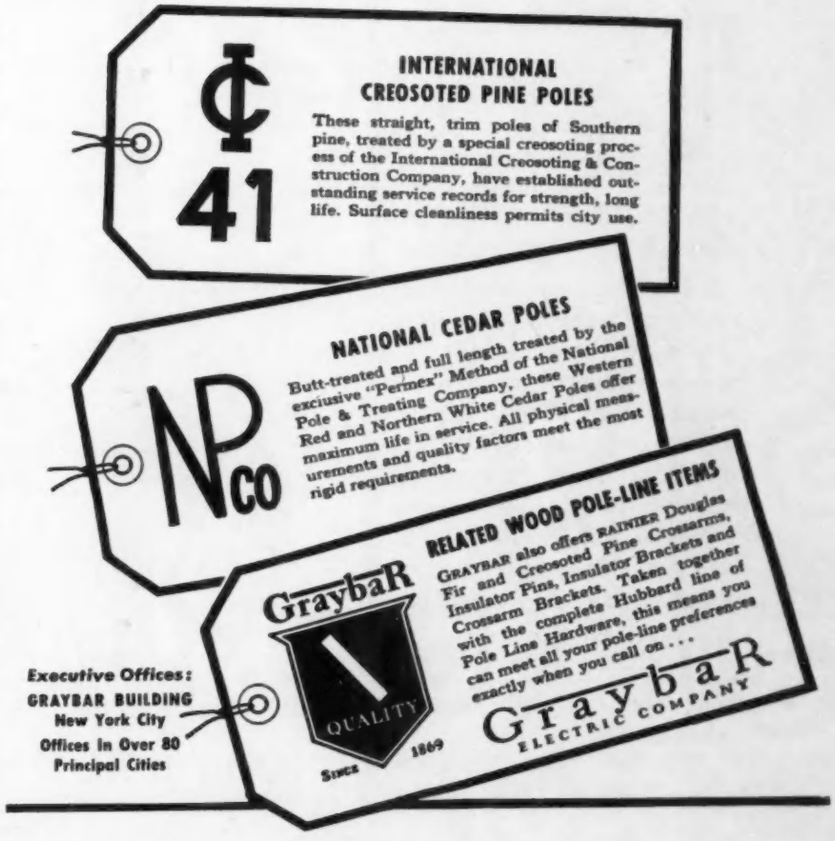
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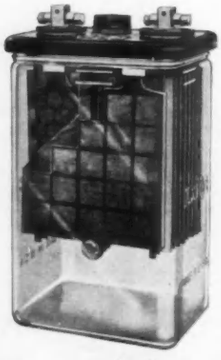
Then telephone crews went to work, with the teamwork that has made them famous. They had to use more than 1,000,000 feet of paired wire in repairing drop wire damage. They had to replace scores of broken poles. But they did this huge emergency job so well that within four days practically every subscriber could use his phone again.

Storage batteries played an important part during this crisis, too, for eighteen of the central telephone offices in the area were affected by power failures. For periods ranging from a few hours to four days, these offices had to rely on standby power from their storage batteries. Four offices used portable charging equipment to recharge their batteries.



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Highlights of the Communications News

Important Communications developments of the past month, briefed for busy readers

by

ROLAND C. DAVIES
Editor, Telecommunications Reports

THE telephone industry of the Nation, Bell System and Independents, has placed itself on a complete defense status with military and other governmental needs and services uppermost, in response to the country's call after the United States became involved in the war with Japan and the other Axis powers.

From now on military requirements will have to be fulfilled to the utmost degree. Next in importance will be the service to maintain civilian defense and morale. Telephone usage for purely civilian business and social needs must and will have to follow behind these two essential operations.

Both the Bell System and the Independents, the latter through the United States Independent Telephone Association, are ready to cooperate in a most complete way with the Army and Navy and other governmental authorities. Ever since the national defense emergency commenced, the telephone industry has maintained a very close liaison with the Defense Communications Board, the Army Signal Corps and the Navy so that the plans for coordination of telephone service with the defense effort have been fully evolved.

Communications Censorship

Censorship of international communications—the cables, radiotelegraph and radiotelephone services—was put into operation promptly and effectively by the Navy as soon as Japan declared war against the United States Dec. 7. The censorship was established first at Manila and Honolulu, then at sunset at San Francisco, at Miami three hours later and at New York City around midnight. The Navy had been training a large staff of officers and enlisted men to administer the censorship for many months, having drawn this personnel from the press, financial houses and other businesses using international communications so that the staff would be equipped to handle speedily legitimate traffic of different specialized kinds.

So far at the time of this writing there were no indications that telephone service was likely to be placed under censorship. There was some thought, however, that the long distance telephone lines from the United States to Mexico, particularly, and Canada might be monitored for the initial part of the war to prevent any Axis espionage or sabotage information being transmitted in or out of the United States. Domestic telegraph traffic also may be censored, it was said by high governmental sources, for the initial weeks of the war so as to likewise block espionage and sabotage communications. The latter step was done in England at the beginning of its war until that country was purged of enemy suspects and subversive elements.

Censorship of domestic broadcasting has been a subject of study by the governmental authorities. The Office of Civilian Defense was thought to be a likely agency to handle this form of censorship, if it is inaugurated. Such censorship would probably be done at the main outlet of broadcasting networks. Because of the dangers of exaggerated war situations, especially air raid threats, in causing highly disturbed and hysterical reactions among the public, censorship of broadcasting news programs may become necessary.

Priorities Needs

THE priorities situation for the telephone industry still remains undecided, but the envolvement in war was felt by many to eliminate some of the pressure for the designation of a distinct government agency or agencies to handle the industry's strategic materials and metals needs. There is no question but that the telephone industry due to the war is to be geared more and more to defense services. **Therefore, telephone manufacturing companies will be required in an ever-increasing degree to produce defense apparatus and equipment for the Army and Navy with a great dimunition of production for civilian telephone facilities.** As the telephone manufacturing industry is turned more and more into defense production, the tightness of its priority situation will be lessened since defense contracts for military purposes will be granted satisfactory priority ratings.

This turn of the telephone industry into defense operations was exemplified by the determination of SPAB and OPM to reduce drastically the flow of strategic metals into defense needs which was made shortly after the declaration of war. President Roosevelt stressed that civilian manufacturing uses of defense metals and materials would have to be cut to the bone with the thought that the present supply of civilian materials would in all probability be reduced in half of the present allocations.

In his radio address to the nation on the night of December 9, President Roosevelt made specific mention of strategic metal shortages for civilian use. He said:

"There will be a clear and definite shortage of metals of many kinds for civilian use, for the very good reason that in our increased program we shall need for war purposes more than half of that portion of the principal metals which during the past year have gone into articles for civilian use. We shall have to give up many things entirely.

Rationing

TELEPHONE companies must also expect to have the threat of rationing of civilian telephone service greatly expedited by America's entrance into the war. The prospect of considerably increased four-party telephone service for civilian users together with the reduction and elimination of extension stations, has become much more definite with America's participation in the war. Curtailments for civilian service of a non-essential character appear most certain on the horizon due to the war.

Labor Peace

THE war should spell "30" to strikes of labor and representatives of industry and labor are to be called together by President Roosevelt to work out plans for arbitration and cooperation over union disputes. This will mean that in the telephone industry the spectre of walkouts by employees such as was threatened by the employees' group in the American Telephone and Telegraph Long Lines will will be dispelled for the duration of the emergency.

This may obviate the necessity of enactment by Congress of a drastic anti-strike law which would permit the government to take over plants and facilities where walkouts have occurred. The Senate, although previously leaning towards a milder form of labor legislation, had been pictured after the declaration of war as willing to approve a drastic anti-strike measure like the Smith bill passed by the House.

Strike Settled

THE Long Lines strike was settled during the last few days of November by the Federal Conciliators with an increase of between $2,500,000 and $3,000,000 in wages annually for approximately 15,000 employees. Another telephone labor development occurred in early December when the Keystone Telephone Employees Association secured FCC permission to file a brief in the FCC case involving the first step of the acquisition of that Independent telephone company's properties in Philadelphia and Southern New Jersey. In their brief to the FCC the Keystone employees stressed that their rights, both as to employment and pensions, must be preserved in any consolidation—the Bell of Pa. and the New Jersey Bell had both assured the Commisison that the Keystone employees would be fully safeguarded.

COMING CONVENTIONS

Kentucky Independent Telephone Association, Brown Hotel, Louisville, December 12 and 13.

Minnesota Telephone Association, Radisson Hotel, Minneapolis, January 27, 28 and 29, 1942.

Texas Telephone Association, Hotel Adolphus, Dallas, March 18, 19 and 20, 1942.

Pennsylvania Independent Telephone Association, Sterling Hotel, Wilkes-Barre, May 21, 22 and 23, 1942.

Missouri Telephone Association, Muehleback Hotel, Kansas City, November 16, 17 and 18, 1942.

HUNTER L. GARY NAMED

Hunter L. Gary

The Associated Telephone and Telegraph Co., the Theodore Gary & Co. subsidiary which operates telephone properties and engages in telephone construction and engineering outside the United States, has designated Hunter L. Gary, Chairman of its Board, to assist the Interdepartmental Committee organized by Nelson Rockefeller, Coordinator of Inter-American Affairs, to study communications in the American Republics. Frank S. Spring, president of the Associated Telephone and Telegraph Co., was named alternate to Mr. Gary on the Committee advisory setup.

In making the appointments, the Executive Committee of the Associated Telephone and Telegraph Co. in a message to Mr. Rockefeller from Mr. Gary stated that the company desires to "cooperate with the Government in every way possible" to aid the defense program.

Mr. Gary has been most active and constructive in many important phases of the defense program of the United States, particularly in communications matters. He has been working closely with the highest officials of the War and Navy Departments and has carried out important communications surveys of a highly confidential nature for the Army, and the Navy at their request. He has likewise been active on many important assignments for other leading defense agencies.

Inspects Caribbean Areas

Major General Dawson Olmstead, Chief Signal Officer

MAJOR General Dawson Olmstead, Chief Signal Officer of the Army, has just completed an inspection tour of the communication installations and operations in the Caribbean Defense Command, covering the Panama Canal Zone, Trinidad, British Guiana, Porto Rico, Cuba and other places. His tour was interrupted by the involvement of the United States in the war with the attack of Japan in the Pacific and the declarations of war by Germany and Italy. On his trip to these vital defense areas in the Caribbean, General Olmstead was accompanied by Col. C. O. Bickelhaupt, assistant vice president of the American Telephone and Telegraph Co.

Just before he left Washington for this tour General Olmstead had called a meeting of his Advisory Council and newly formed Advisory Board which during its sessions was addressed by Secretary of War Stimson, Undersecretary Robert P. Patterson and General George C. Marshall, Chief of Staff, together with three Deputy Chiefs of Staff. From the telephone industry there were three representatives on the Advisory Council and Board. They were Lt. Col. William Carter Henry, general manager of the Northern Ohio Telephone Co., representing the Independent industry, and Col. Bickelhaupt of the Bell System, while on the Board was Dr. Frank B. Jewett, chairman of the Bell Telephone Laboratories board of directors, who is to advise the Signal Corps on the determination of apparatus designs and coordination of equipment uses by the Army.

EDITORIAL

Our World Is Changed

THE first bomb released by a Japanese airman in the treacherous attack upon Hawaii Sunday, December 7th, changed vastly the whole course of events and activities in these United States.

Much that was important to us Saturday was of insignificance Monday. Many of the activities that before Sunday were being assidiously carried on by telephone men and managements, by public service commissions, by associations and committees and in other ways are now, in the face of this new and terrible situation, of such relative unimportance that men have neither the incentive nor the heart to carry them on.

We have a new job to do; the biggest job ever undertaken by the American people. We must—and we will—force the payment with compound interest, by a venemous and unprincipled enemy, of a debt due us and civilization.

That job is going to take every ounce of our national energy and all our available resources. While we are doing it, many meritorious activities suitable to peace time will have to go undone. You don't go around washing the windows while the house is burning down!

The telephone industry will, as always, support the Government and do its full part or more. Telephone communication is vital to national defense and national morale. Because of the shortage of many metals urgently and in some cases desperately needed for the prosecution of the war, telephone managements will have to use great ingenuity at times in providing service; they may even at times lack at least some materials necessary for maintenance and repair.

It will be weeks before the full impact of this present and coming situation is felt by business and people generally. Meanwhile the telephone industry and all those concerned with the maintenance of telephone service can and should realize and face the situation and clear the decks of now non-essential activities, so that the whole of the energies and resources of the industry can be used to the greatest extent possible for the one thing that now counts, which is the winning of this war.

Production Requirements Plan Announced by OPM

By ROLAND C. DAVIES

Washington—(Special to Telephone Engineer)

THE OPM Division of Priorities took a long step in the direction of a complete changeover to a system of allocations Dec. 3 with the announcement of its long-heralded Production Requirements Plan, providing a standing preference rating for three months at a time for defense contractors and manufacturers, based on their needs of strategic metals and materials in the fulfillment of scheduled defense contracts. Regarded as a streamlined method of obtaining preference ratings, the Plan will provide priorities for manufacturers on that volume of their business deemed as defense, and replaces the Defense Supplies Rating Plan, under which defense contractors were given an A-10 rating on their defense needs.

Of special importance to the telephone industry in the OPM statement announcing the Plan is the statement that "the recommendations of the appropriate industrial branches of the Office of Production Management" will be taken into account by the Priorities Division in determining the preference ratings to be given applicants and the emphasis placed on "essential civilian needs."

The new program will prevent the filing of scores of PD-1 forms now required of contractors with any sizeable volume of business. But, and apparently more important in the long-range policy-making of OPM, the "applications filed . . . will contain information needed by the Office of Production Management for a clear picture of existing inventories and prospective needs for scarce materials." This is another indication that the long-expected combination system of allocations under a preference rating system is nearing, and will come when OPM has more definite information regarding the needs of each industry for strategic materials.

Manufacturers applying for priority assistance under the Plan will be required to show on new form PD-25A the type and volume of products manufactured, their use in relation to defense or **essential civilian needs,** the amount of scarce materials on inventory, and the additional amounts required to fill production schedules for the next calendar quarter. The Plan will first go into effect for the Jan. 1-March 31 quarter.

In determining what preference rating will be allowed each applicant, OPM will take into consideration the amount of defense or essential civilian production involved, the end use of the products, the material, required, and the overall policies of SPAB, as well as the recommendations of the various industrial sections. It is expected that under present OPM policy the recommendations of the industry sections will be of paramount importance, since they have been specifically set up to relieve the Priorities Division of much of its spade work.

It is emphasized that manufacturers may receive several or more separate ratings under the Plan. If all the products covered in the application are destined for defense or essential civilian use, the applicant may be given a blanket rating covering 100% of his needs. Otherwise, the rating will apply only to the percentage of the materials requirements which will be directly incorporated in products regarded as being of basic importance to defense. Thus the producer may receive one or more ratings under the Plan, depending on the equipment he produces and its bearing on defense.

It is expected that eligible producers will be able to obtain all their materials requirements without the necessity of filling out a multitude of PD-1 forms for each separate material needed. The amount of paper work involved in filling defense orders should be substantially reduced.

OPM anticipates that the Plan will simplify the work of defense contractors considerably, and will result in a considerable speeding up in doing business. Under the old program, producers were given the alternatives of using the Defense Supplies Rating Plan, with its almost useless A-10 rating for defense orders only; getting preference ratings for each individual order and going through the red tape of extending them to sub-suppliers; or making many separate applications.

Further indication that the Plan is a definite move in the direction of allocations is contained in the OPM statement that "As this information is obtained from all manufacturers handling defense or essential civilian orders, the Office of Production Management will be able to build up an overall picture of materials use and prospective requirements for defense. When the picture is reasonably complete, it will be possible to assign priority ratings with more exact relationship to the importance of a particular manufacturer's product and the total volume of materials available.

"The new plan is to be applied first on a company basis. It is expected to form the foundation for similar plans on an industry basis as rapidly as the overall needs of the various industries are known."

The Plan provides that interim reports may be filed to allow for changes in materials needs and production schedules within a particular quarter. When a producer finds it necessary, because of long-term commitments, he may file an application for the second quarter at the same time he files one for the first quarter. Applications must be made by full quarters, however.

The Plan, as is usual in OPM priority orders, may be used only to obtain those critical materials on the list known as Materials List No. 1. It cannot be used to obtain production equipment, like machine tools, which must be obtained under the usual PD-1 form. Preference ratings received are extendable to suppliers by a prescribed endorsement on the order, and suppliers may extend the terms of the priority order on to their suppliers.

Trial Comparative Cost Studies Manual to Dial Conversion

PART II

By EMMETT D. TALBOT
Consulting Telephone Engineer
Rochester, N. Y.

CONCLUSION

In order to illustrate this method of approximating the cost of the operation of an existing manual system and a proposed dial system there follow two examples. One of an unattended dial system replacing a manual common battery system and the other a dial system which required a toll switchboard in conjunction with the dial central office equipment.

THE two examples give consideration to the tangible costs, that is, the first cost of the various items of plant involved in the conversion under consideration, the annual charges on the first cost of plant and the operating expenses. Under operating expenses it should be noted that no item for commercial expense has been included. Usually there is no tangible item of commercial expense involved in the conversion of a manual to a dial system. In some cases however, there is some commercial expense to be considered. For example, in some small exchanges an operator may also act as the commercial representative in which capacity she meets the public and performs the usual commercial duties of collecting accounts, accepting orders for new installations, etc. In such cases, it is often necessary to continue to employ some person to act as the company's commercial representative after a conversion. Such cost, if necessary, should be charged against the proposed dial system.

In general the commercial aspect to be considered in connection with a conversion to dial is of intangible value

EXAMPLE NO. 1

X Telephone Company

First Cost—Present Manual and Proposed Dial Central Office Equipment, Plant and Telephones

	Present Common Battery Manual	Proposed Dial
Number of Lines	185	185
Number of Stations	262	262
First Cost		
1. Land		$ 200.00
2. Building	$3,000.00	1,500.00
3. Manual C. O. Equipment	5,223.00	
4. Dial C. O. Equipment		?
5. New Cable Plant		500.00
6. Telephones	5,699.40	7,163.85
Total First Cost less Dial C. O. Equip.	$13,922.40	$9,363.85
Annual Charges		
1. Land		
2. Building 10%	$ 300.00	$ 170.00
3. C. O. Equipment 13.9%	725.99	
4. New Cable Plant 11%		55.00
5. Telephones 14.2%	809.31	1,017.27
Total Annual Charges less Annual Charges on Dial Equipment	$1,835.30	$1,242.27

Operating Expenses	Present Manual	Proposed Dial
1. Operator's Salaries, and Pay Roll Taxes	$3,458.24	
2. Maintenance Telephones (5 cents per dial)		$ 13.10
3. Maintenance C. O. Equip.*		150.00
4. Heating	110.00	30.00
5. Light and Power.*		
Total Operating Expense	$3,568.24	$ 193.10
Annual Charges less Annual Charges on Dial C. O. Equipment	$1,835.30	$1,242.27
Total Annual Charges and Operating Expenses, less Annual Charges on Dial C. O. Equipment	$5,403.54	$1,435.37
Amount Available in favor of Dial to pay Annual Charges on Dial C. O. Equipment	$3,968.17	

and although it cannot be expressed in our cost comparison, it should have serious consideration.

$3,968.17 is 13.9% of $28,547.98. It was therefore, assumed that as much as $28,000 could be expended for dial equipment and still break even with the present manual in annual charges and operating expenses. It was of course realized that the dial equipment required would cost much less than $28,000 so the suppliers were furnished with traffic data and the over all equipment requirements.

The dial equipment was ordered and installed and the final First Cost was $13,033.20. The annual charges at 13.9% amounts to $1,811.61. Deducting the annual charges from $3,968.17 leaves $2,156.56 annual saving in favor of dial operation.

THE second example considers a common battery manual office having a five-position common battery switchboard, two positions of which are local, one combination local and toll and two toll positions. This switchboard serves 563 telephones and is the toll center for three small connecting company offices.

A study was made to determine if it would be more economical to convert to dial operation or to continue manual operation.

The building housing the manual switchboard was company-owned and it was believed there was sufficient floor space to house a dial equipment in addition to retaining three manual positions for toll operation.

A preliminary study was made similar to that outlined under Example 1 above, in order to determine how much money if any could be saved over manual operation, less the annual charges on 300 lines of dial equipment.

$1,799.64 is 13.9% of $12,947.05. Approximately $13,000 can be expended for dial equipment to break even with the present manual operating costs. As 300 lines of dial equipment are needed, only $43.00 can be expended per line for dial equipment. For an office of this size dial equipment will cost from $60.00 to $80.00 per line depending upon the traffic, trunking and operating refinements desired.

If we allow $60.00 per line to cover the cost of dial equipment installed, including the telephone companies' engineering expense and the expense incidence to cut-over, 300 lines will cost $18,000.00 which amount is on the low side. A first cost of $18,000 represents an annual charge at 13.9% of $2,502.00. This is $702.36 more than the estimated difference of $1,799.64 of the Manual and Dial-annual charges and operating expenses. All other things being equal, it is doubtful if a conversion to dial in this case would be justified at this time.

Small companies who believe that a conversion of their existing manual systems to dial operation is indicated should apply the method outlined above to determine if there appears to be sufficient saving in annual charges and operating expenses to warrant the considerable engineering and extra work involved that is required to make a detailed cost study. If a peliminary cast up of the annual charges indicate a substantial amount of money in favor of dial operation, such as indicated in Example No. 1, then the company can safely go ahead and obtain firm quotations on dial equipment to meet their particular conditions.

In addition to giving consideration to the present and proposed costs, along the lines suggested in the examples, serious consideration as previously pointed out, should be given to the intangible commercial aspect of the conversion problem.

LET the importance be emphasized at this point, on the need of making a thorough study of each situation in order to learn whether or not the various intangible commercial and other operating contacts with the public will be maintained and carried out before dial equipment is installed. It must be borne in mind, that in many small communities the telephone operator not only operates the switchboard, but prepares the subscribers' bills, keeps the accounts, collects the money, even directs the clearing of trouble by the plant man and is in effect the personal representative of the company to the entire community represented by the telephone subscribers and the non-subscribers as well.

It is further emphasized that before this representation, which is usually considered as a commercial function,

(Please turn to page 28)

EXAMPLE NO. 2

Y Telephone Company

First Cost—Present Manual and Proposed Dial Central Office Equipment, Plant and Telephones

	Present Manual	Proposed Dial
Number of Lines	300	300
Number of Stations	563	563
First Cost		
1. Land	———	———
2. Building	———	———
3. Manual C. O. Equipment	$9,760.46	———
4. Dial C. O. Equipment	———	?
5. Three Position Toll Swbd. (Reused) (Manual)	———	$ 4,250.00
6. Cable to tie present cables to new M. D. F.	———	350.00
7. Telephones	11,625.95	16,229.15
Total First Cost less Dial C. O. Equipment	$21,386.41	$20,829.15
Annual Charges		
1. Land	———	———
2. Building	———	———
3. Manual C. O. Equipment 13.9%	1,356.70	———
4. Dial C. O. Equipment 13.9%	———	———
5. Three Position Toll Switchboard 13.9%	———	590.75
6. New Cable 11%	———	38.50
7. Telephones 14.2%	1,650.88	2,304.54
Total Annual Charges	$ 3,007.58	$ 2,933.79

Operating Expenses	Present Manual	Proposed Dial
1. Operators' Salaries, and Taxes	$8,060.00	$5,806.00
2. Maintenance Telephones (5 cents per dial)*	———	28.15
3. Maintenance C. O. Equip.*	———	500.00
4. Heating*	———	———
5. Light and Power*	———	———
Total Operating Expenses	$8,060.00	$6,334.15
Total Annual Charges less Annual Charges on Dial Equipment	3,007.58	2,933.79
Total Annual Charges and Operating Expenses less Annual Charges on Dial C. O. Equipment	$11,067.58	$9,267.94
Amount available in favor of Dial to pay Annual Charges on the Dial Equipment	$ 1,799.64	

Wire Chief's TRAINING COURSE

SECTION X

Drop Wire Construction

(Prepared Expressly for TELEPHONE ENGINEER by the Lincoln Engineering School)

General

DROP wire which is the link between the subscribers telephone and the distribution plant is the most perishable of the several types of outside plant. Even though properly installed it may be expected to have a materially shorter life than cable or open wire. When improperly installed it will have a life of only a few years and will be a source of maintenance expense.

One of the principal factors tending to shorten the life of drop wire is inadequate tree clearance. If tree limbs are allowed to rub against drop wire the insulated covering will be damaged and the bare wire exposed, resulting, particularly in common battery plants, of current leakage which will interfere with the proper operation of signaling apparatus. Inadequate sag and poorly made ties are also prolific sources of drop wire trouble and short life.

Drop Wire Clearance

A prime consideration is that drop wire be placed with proper clearance over highways, driveways, and spaces accessible to pedestrians. Adequate spacing between power and drop wires is also of importance if undue hazards are to be avoided.

The correct clearance requirements have been set up by the National Electric Safety Code Rules, Handbook H 32, and should be carefully followed. In some states laws are in effect which require slightly greater clearance than that specified by the Handbook and in such cases the state law should always apply. Table No. 1 gives the code clearances for drop wires at crossings over highways, railroad tracks and private driveways. The proper clearance between power and telephone wires of various voltage classifications is given in Table No. 2. Failure to provide proper clearance may result in a serious accident with consequent expensive civil suit against the telephone company.

TWISTED PAIR DROP WIRE

PARALLEL DROP WIRE

Fig. 1—Two Types of Drop Wire.

Types of Drop Wire

THERE are two basic types of drop wire in general use, as shown in Fig. 1—namely: (1) twisted pair, and (2)

Clearance in Feet Where Drop Wires Cross Over	Clearance
Steam R. R. Tracks	27 Feet
Public Streets, Alleys or roads in urban or rural districts	18 Feet
Note: May be reduced to 15 feet at alley crossings.	
Driveways to Residence Garages	10 Feet
Spaces or ways accessible to pedestrians only	8 Feet

Table No. 1—Minimum Vertical Clearance of Drop Wires Above Ground or Rails

Clearance in Feet Where Drops Cross under Power Wires	Clearance
0-750 Volts	
Power Service Drops	2 Feet
Power Line Wires	4 Feet
Note: Clearance to line wires may be reduced to 2 feet where crossing is not closer than 6 feet to a crossing pole.	
750 to 8700 Volts	
Power line or Drop Wires	4 Feet
Note: Clearance should be 6 feet where power wires are within 6 feet horizontally of a communication pole.	
8700 to 50,000 Volts	
Power Line Wires	6 Feet
Note: Multi-grounded Y circuits not exceeding 8700 volts to ground may have 4 foot clearance, if not within 6 feet horizontally of a communication pole.	

Table No. 2—Wire Crossing Clearances for Drop Wires

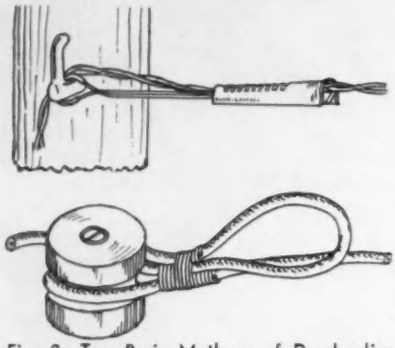


Fig. 2—Two Basic Methons of Deadending Drops.

parallel. Parallel drop wire consists of two rubber insulated conductors which lay parallel to each other and which are enclosed in a textile braid. Twisted pair drop wire consists of two rubber insulated wires each separately insulated with rubber, covered with a textile braid and twisted together. The textile covering is treated with a bituminous compound to prolong its life. Some form of flake mica is often used over the compound to make the wire easier to handle. The size drop wire in most common use is **No. 17 B & S gage** and is available in several different conductor materials viz: bronze, copperweld, or special iron conductors. The No. 17 bronze conductor has a breaking strength of approximately 200 lbs. per conductor and in the twisted pair type weighs approximately 33 lbs. per thousand feet. The weight of the parallel wire is slightly less. Copperweld twisted pair drop wire weighs approximately 32 lbs. per thousand feet and also has a breaking strength of approximately 200 lbs. Twisted pair iron drop wire is available in sizes 18 and 19 B.W.G. and weighs 39 lbs. and 27 lbs. respectively and has a tensile strength of approximately 170

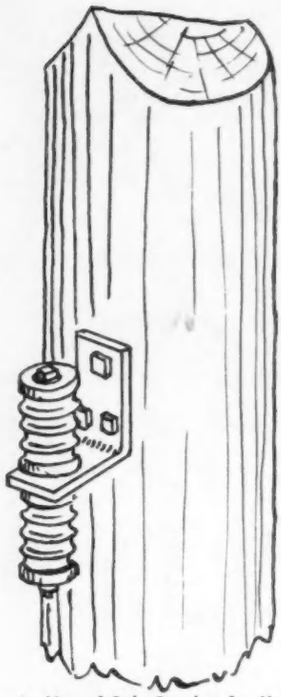


Fig. 4—Use of Pole Bracket for Knob Support.

lbs. per conductor. The choice between these three types of drop wire will depend largely on the supply situation and the personal preference of the user.

The larger telephone companies have especially made up for their use, drop wire having a special wear resisting braid which is used where drops must be placed thru or in close proximity to trees. This special wear resisting braid will last longer and thus justifies its higher cost for bad tree situations.

Drop Wire Supports

THERE are a number of different types of insulators and brackets

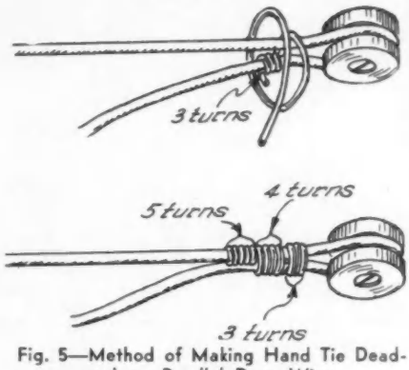


Fig. 5—Method of Making Hand Tie Deadend on Parallel Drop Wire.

which are used for dead ending drop wire, and for supporting the wire at intermediate points in a drop wire run. It was formerly the practice to use porcelain insulators and hand ties for all drop wire supports. In recent years, however, considerable use is now made of what is known as **drop wire clamps**, and these eliminate to a large extent the necessity for hand ties and insulators. The two basic methods of dead ending drop wire is illustrated in Figure *2*.

The porcelain knobs used for twisted pair drop wire are somewhat different than those used for parallel wire, the essential difference being that the grooves in the twisted pair knobs are rounded while those used for parallel wire are more rectangular. The several types of knobs are shown in Figure *3*.

There is also available a special self-tying knob (see fig. 3) which can be used for twisted pair wire and which eliminates the tie wire. This knob is not intended for deadends but only for support of drop wire at intermediate points in a run.

(Please turn to page 37)

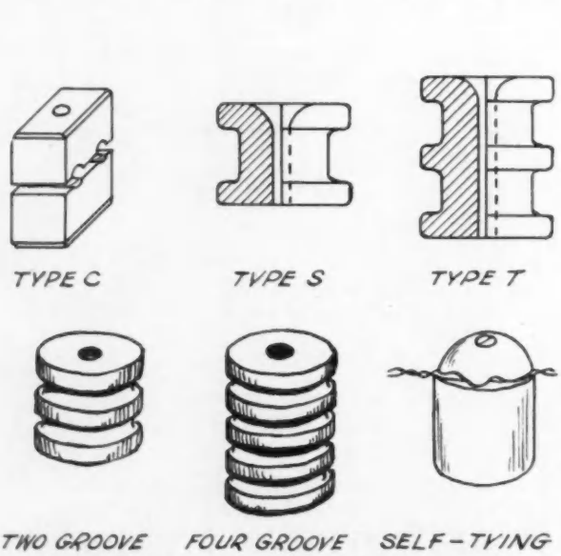


Fig. 3—Porcelain Knobs for Parallel and Twisted Pair Drop Wire.

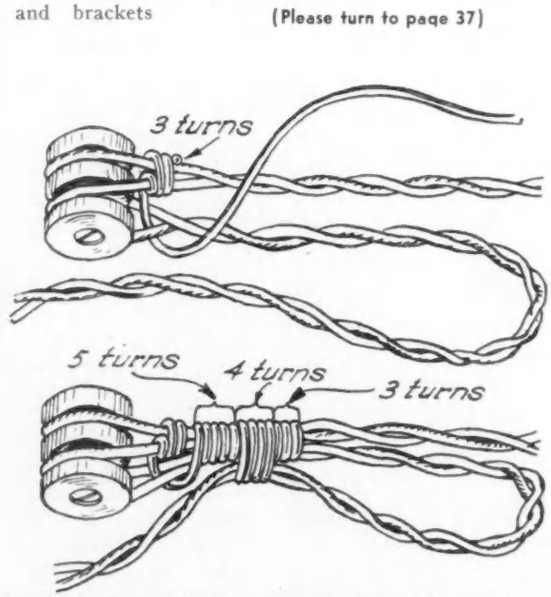


Fig. 6—Method of Making Hand Tie Deadend on Twisted Pair Drop Wire.

QUANTITATIVE DESIGN OF CENTRAL OFFICE EQUIPMENT FOR SMALLER TELEPHONE OFFICES

(Continued)

By JAY G. MITCHELL

In this installment Mr. Jay G. Mitchell brings to TELEPHONE ENGINEER readers additional information on Quantitative Design on Central Office Equipment discussing Factors Dependent on Type of Equipment and much valuable information on the Magneto Office.

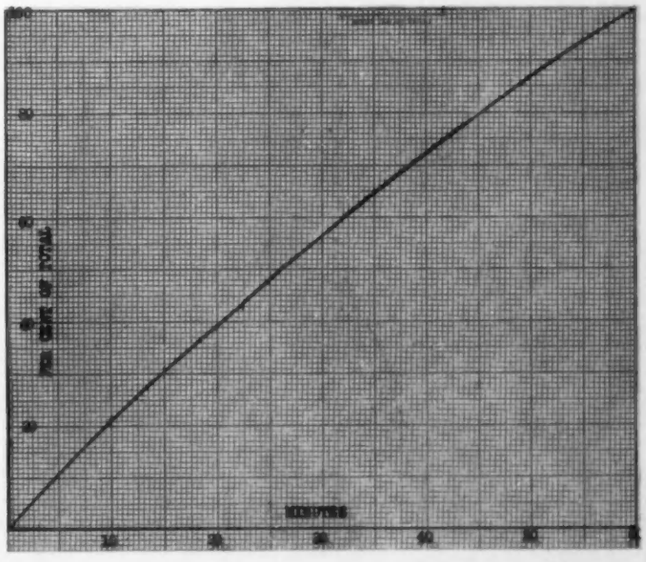
Factors Dependent On Type of Equipment

IT IS, of course, necessary to base the quantitative design of many items of the Central Office Equipment upon considerations dictated not only by the size of the telephone office and by the traffic demands, but also those which are characteristic of the type of equipment. For illustration the Main Distributing Frame required for a magneto office to serve a given number of incoming cable pairs and to handle a definite volume of traffic would, in all liklihood be of a different size and possibly of a different type from the Main Distributing Frame suitable for a dial office.

Because the selection of the type of Central Office Equipment hinges upon considerations both economic and otherwise it is quite likely, of course, that the decision will have been made prior to any attempt to work out the physical design of the office. The matter is mentioned, however, to insure that a condition may not arise in the progress of designing the physical equipment for the office which will necessitate expensive and annoying adjustments and revisions disclosed because the decision as to the type of equipment has not previously been made.

The Magneto Office

While modern telephone service in larger offices seems to demand the use of common-battery or dial equipment, the importance of a large number of magneto equipped offices in maintaining dependable telephone service to every accessible point in the nation cannot easily be overstated. Regardless of all other considerations the fact remains that for many of the smaller telephone systems magneto equipment for some time to come will afford satisfactory and dependable service. It is also true that economic considerations in smaller telephone systems often prescribe the inauguration of a modernization program looking to the replacement of the magneto equipment by some other type. Such economic considerations are, of course, of the greatest importance and must be given the most careful executive consideration. Upon the basis of the most careful consideration of such factors, however, the selection of the type of equipment to be installed in the new or rehabilitated office under any given set of plant, traffic and financial conditions must be made. It is after the selection of the type that the Quantitative Design Of The Central Office Equipment may be successfully initiated, but



Per cent of total busy hour calls occurring in peaks of various number of minutes duration.

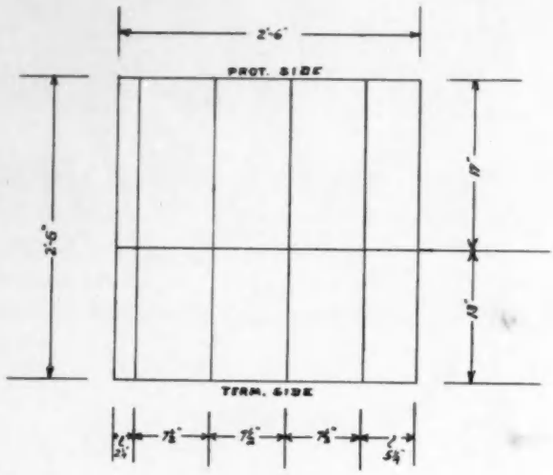


Fig. 1

Outline of floorplan template for 400 pair, Type "B", Cook, M.D.F. 100 protectors high, scale 1½ inch = 1 foot

it should not be attempted until after a definite decision as to the type has been made.

Assuming therefore that the proposed Central Office is to be equipped with magneto equipment it then becomes necessary to decide:

A—The number of Line Equipments to be initially provided for exchange service.

B—The number of Toll Line Equipments (serving both toll circuits and free inter-exchange circuits) to be provided.

C—The number of Connecting Cord Circuits to be provided.

E—The number of originating calls which must be handled during the "busy hour."

In the Magneto Office either the type "A" or type "B" Main Distributing Frame may be used. In the opinion of the author the selection of either type "A" or type "B" is largely a matter of individual choice subject to the considerations as to initial capacity which must be provided. It should be remembered, as a general controlling factor for consideration, that in the type "B" Main Distributing Frame all of the Central Office Equipment, including the jumper wire, will have the benefit of the main frame protection against damage from extraneous current. For very small Magneto offices a type of equipment has recently been placed on the market which is essentially a very compact type "B" Main Distributing Frame for wall mounting. In this type of terminating equipment unit-type protectors (which are interchangeable with the protectors in the corresponding line of substation protectors) and which may be added pair by pair as needed, are used. The distribution is effected by means of short jumpers running to a switchboard terminal block mounted directely on the cable terminating head.

A TYPE of large capacity Main Distributing Frame which is also mounted on the wall is common where the amount of floor space required for the Central Office Equipment is limited. The capacity of the iron framework of the Main Distributing Frame and the number of protectors which must be provided are, of course, entirely subject to the considerations previously pointed out.

The number of line circuits in the switchboard of the small Magneto office for exchange service which must initially be provided should, in the author's opinion, be approximately ten per cent in excess of the number of subscribers' line circuits presently assignable to the office. Executive consideration of the conditions to be met, however, may easily dictate the provision of a smaller or larger initial excess in subscribers' line circuits than the ten per cent suggested. In this item of the equipment it is important to remember that subscribers' line circuit equipments which cannot be placed in actual service within a few months involve an unjustifiable Fixed Capital expenditure. Furthermore, it is important to remember that the addition of subscribers' line equipments in offices of this character is a comparatively simple and inexpensive procedure. The practice, which was somewhat common at one time, of installing extra subscribers' line equipments initially to provide spare parts for maintenance is not justified except to a very small extent.

The ultimate capacity, that is to say the number of subscribers' line circuits which can ultimately be installed in the switchboard section is largely a matter to be determined by the volume of traffic to be handled in the office and may well be left for final determination until consideration is given to the number of operators positions. Many Magneto Offices, however, in which only one operator's position can be justified will always be important elements in the nation wide system of telephone communications.

The number of toll line circuit equipments (serving both toll circuits and free inter-exchange circuits) to be initially installed need only be sufficient, of course, to afford access to all such circuits entering the office. The electrical characteristics of such line equipments, however, should be carefully worked out with the manufacturer of the equipment at the time of placing the order, because it is very important that the electrical design of the toll line circuit equipment, shall be such as to eliminate all possible transmission loss.

In formulating the requirements for connecting cord equipment it is necessary that a conservative determination be made of the volume of traffic to be handled. While it is possible in extremely large telephone offices to work out traffic data on the basis of extreme accuracy such refinement is entirely unnessary and may, in fact, be entirely misleading in the case of the small Magneto Office. This is due to several very definite conditions which are characteristic of the telephone traffic in small groups of lines such as are found in small Magneto Offices. It is the experience of the author that the average length of the telephone conservation in seconds is almost certain to be greater in such offices than it is in offices serving larger numbers of subscribers' lines. Without doubt many exceptions may be found to disprove any general rule of this character, but in the absence of definite data to the contrary it is the author's opinion that a average length of conversation of three minutes and an average cord holding time of three and one-half minutes will be conservative in such offices.

THE average conversation time in manually operated offices, in the language of telephone traffic, may be defined as the length of the period after the called party has answered until the disconnect signal is given. The average holding in manually operated offices, in the language of telephone traffic, may be defined as the length of the period after the operator has answered the calling party until both the answering and calling plugs are removed from the jacks there-

(Please turn to page 36)

AUTHOR'S NOTE: Fig. 1, Template for COOK, type "B", 400 pair, 100 pairs high M. D. F. was inadvertently omitted from the issue of November 15, 1941 although it was referred to in the text. This cut is included in this issue.

lways *tomorrow*—

it *today!*

● Every telephone executive can be sure of one thing—that the conditions his exchange must meet tomorrow will be different from those of today. Just how different, it is becoming increasingly difficult to foretell. Changes in traffic conditions, new and different types of service, sudden and unexpected growth—all of these things are likely to occur, and very often when least expected.

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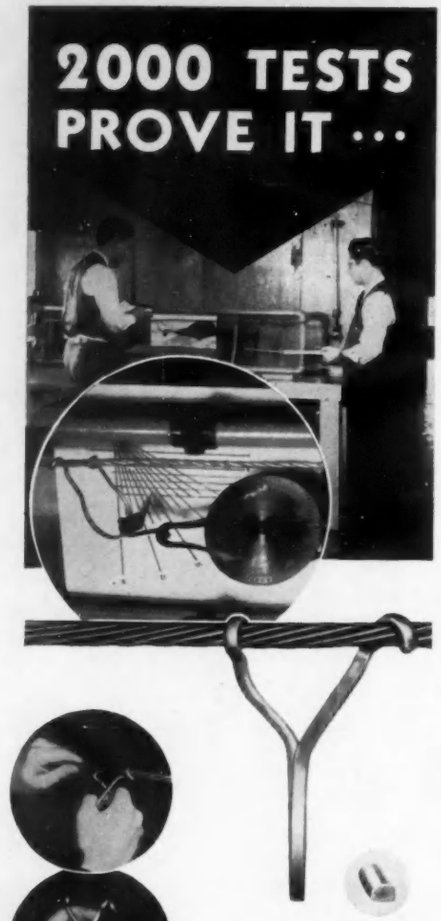

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Installation tests show that Chance Rings are easy to install because their spiral gripping hook provides a leverage.

This hook not only simplifies installation, but prevents slipping in either direction when cable is pulled through.

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2000 tests should give the right answer. It's a cinch you can't go wrong if you specify Chance (No-Tangle Packed) Cable Rings.

A·B·CHANCE CO. CENTRALIA MISSOURI

Trial Comparative Cost Studies —Manual to Dial Conversion

(Continued from page 20)

is changed by the installation of a dial switching system, the company should know how future proper commercial relations will be maintained. These considerations should be studied from the viewpoint of the telephone company complying in each instance with its duties of properly extending to each individual community a complete and satisfactory telephone service from the subscriber's viewpoint, including what is generally referred to as proper commercial relations thereby retaining in the operation of the telephone company in a particular locality, the necessary human relations between the Telephone Company and its subscribers, which experience indicates is of such real value that it cannot and should not be dispensed with nor reduced beyond a reasonable minimum.

In asking for quotations on dial equipment, it is to the interest of all concerned to have available detailed data pertaining to the existing system such as accurate traffic peg counts and holding time data and the number and kind of telephones in service that may be reused by adding the dial, or the number of each type of new dial telephones that will be needed.

In conclusion let it be emphasized again that it is most important to the operating company to make sure that, a conversion of a magneto to either a common battery manual or a dial system, or the conversion of a common battery system to dial operation, "Will Prove In" both financially and from a satisfactory Public Relation's standpoint, before the job of conversion is undertaken.

Dr. Manson Named

Dr. Ray H. Manson, vice president and general manager of the Stromberg-Carlson Telephone Manufacturing Company, has been elected the new Chairman of the Set Division of the Radio Manufacturers Association. This post also carries with it a Vice Presidency of the Association.

Dr. Manson, who has been a director of RMA for several years, was also named by RMA President Paul V. Galvin as a member of the Association's Executive Committee.

Converter For "FM" Is Patented

A converter which can be hooked up on present radio receivers so that they can receive frequency modulation broadcasts was patented a short time ago by Winfield R. Koch of Haddonfield, N. J. The converter, a system of tubes, condensers, and coils, picks up FM waves and changes them into regular amplitude modulated signals, so that they can be heard over the conventional receiver. FM has been hailed as one of the most important developments in the field of broadcasting, since it is virtually static-free. The converter patent was assigned to RCA.

Graybar Elects New Officers

The board of directors of the Graybar Electric Company has elected a new president, Mr. A. H. Nicoll, and three new vice presidents, Mr. G. F. Hessler, Mr. D. H. O'Brien, and Mr. E. W. Cashman.

Mr. F. A. Ketcham, present president, becomes chairman of the board, and the following field vice presidents continue in that capacity: W. P. Hoagland, Chicago; W. J. Drury, New York; and A. L. Hallstrom, Philadelphia.

Mr. Nicoll reaches the presidency after 30 years of service starting as a sales record clerk in San Francisco. Mr. Hessler has had 35 years of service, and Mr. O'Brien 25. Mr. Cashman started in 1912 at Minneapolis.

Rate Hearings Start December 15

Hearing on application of the Lincoln (Nebr.) Telephone & Telegraph company for increases of rates at its Lincoln exchange, along with those at 83 others of its 117 exchanges, will begin Dec. 15 at 10 o'clock in the commission rooms at the capitol.

Delay in fixing the date, the petition having been filed six weeks ago, rose from a desire on the part of the commission to discover if a hearing could be held without involving the sacrifice of a lot of time on the part of the communities interested entitled to be heard, because of the number of exchanges involved. It was suggested that a pre-hearing be held at which a method of procedure could be worked out to lessen the length of the hearing and enable representatives to be present when their towns came up for consideration. But after exploring this possibility the commission decided to set the application down for a hearing in regular order.

Personals from the Field

"Milt" Stewart, secretary of the Pennsylvania association, has just notified us that dates for the 1942 convention of the Pennsylvania Independent Telephone Association had been set for May 21, 22 and 23, at the Sterling Hotel, Wilkes Barre, Penn.

•

Bert Morton, general equipment supervisor of the Associated Telephone Co., Ltd., Santa Monica, Cal. was fatally injured by an automobile early in December. The loss of two key men in that organization in recent weeks combined with unusually busy times occasioned by defense work will be keenly felt. **Ernest Irwin,** as our readers will recall passed away only a few weeks ago.

•

D. J. Paisley, manager of the Lohrville, Ia., exchange was one whose lines suffered much damage from the recent snowstorm in northern Iowa and southern Minnesota. He reports many broken poles, crossarms and several hundred leaning poles.

•

Arthur E. Moore, Monroe, Ia., who has operated in the telephone business for the past 8 years in Monroe, has moved to Sloan, Ia., following his purchase of the Sergeant Bluff and Sloan exchanges from the Central West company. No purchase price was announced.

•

Frank Lane, Decatur, Ill., formerly general superintendent of the old Cape Girardeau Telephone Company when A. R. Ponder headed the firm, died recently at Decatur.

•

Ralph Van Trine, vice president of the Durham (N. C.) Telephone Company, was recently made a director of the North Carolina Independent Telephone Association.

•

Otto Morris, manager of the Citizens Telephone Company, Fairmount, Ind., is convalescing in an Indianapolis hospital from a tumor operation performed during October. Late reports indicate steady improvement.

•

Miss Belle Bernetha, formerly chief operator of the Rochester (Ind.) Telephone Company, and now retired after 44 years of service, was honored guest at a luncheon given by members and guests of the Telephone Pioneers of America recently.

R. C. Appling, superintendent of the telephone and telegraph department of the United Gas Pipe Line Company, recently completed tests on that company's new telephone line from Hattiesburg, Miss. to Mobile, Alabama. United has connecting lines extending to Mexico.

•

Kenneth L. Schroeder has succeeded **J. F. Smith** as manager of the Ohio Community Telephone Co. at Cadiz, O. Schroeder for the past three years has been manager of the Wisconisco Tel. & Tel. Co., Elizabeth, Penn.

•

R. V. Achatz, president of the Indiana Telephone Association reports good

(Please turn to page 41)

New A. T. & T. Vice President

M. R. Sullivan, who has been Vice President in charge of operations of the Pacific Telephone and Telegraph Co. since 1939, was elected Vice President of the American Telephone and Telegraph Co., effective Dec. 1, by the

M. R. Sullivan

A. T. & T. Board of Directors at their regular quarterly meeting Nov. 19. Mr. Sullivan will be in charge of the Department of Operation and Engineering of the American Telephone and Telegraph Co. during the absence of William H. Harrison, who is on leave as Director of the Production Division of the Office of Production Management in Washington.

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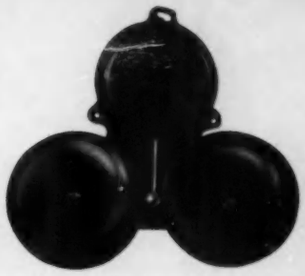

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Conducted by B. C. BURDEN, Technical Editor

Line AND Desk

Substation and Cable

Q. What is the capacity in microfarads of ordinary paper insulated cable?

A. Cable will range from .060 to .075 m. f. per mile. The looser the core of the cable the lower its capacity.

Q. What is the average voltage at which lightning arresters will arc over?

A. This will depend upon the type of arrester and the air gap spacing. The ordinary arrester such as is used in substation arresters and on mainframes are usually designed to break down at from 350 to 400 volts.

Transmission

Q. Will a loose receiver cap effect the efficiency of the ordinary receiver?

A. A loose cap will cause a loss as much as 6 decibels (75% loss) in receiving efficiency. The caps are arranged to clamp the receiver around its edge, which tends to improve its resonance characteristics near the middle of the voice range.

Q. What is the correct air gay spacing on the older type receivers?

A. A spacing of .015 inches between pole face and diaphragm is recommended.

Q. What effect on transmission on a rural line does eavesdropping telephones have?

A. The transmission loss resulting from receivers off the hook other than the talking and listening subscribers is roughly 3 decibels per eavesdropper. This is equivalent to saying that each eavesdropping subscriber cuts the transmission 50%. If there were 3 eavesdroppers, the telephone circuit would be only 12½% as effective, as compared to the condition under which there is no eavesdropping.

Q. Why are the steel insulator pins of each pair of some long distance circuits connected together by a short piece of wire?

A. This is done to reduce the dielectric loss resulting from the capactitative current which tends to flow between the insulator pins. By providing a low resistance path as compared to the high resistance path through the wood less energy is lost on a long line. This is of value chiefly where high frequency carrier circuits are carried on the pole. Fig. 1 illustrates the manner in which the tie wire is used.

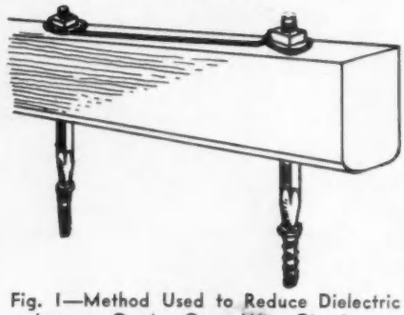

Fig. 1—Method Used to Reduce Dielectric Loss on Carrier Open Wire Circuits.

Outside Plant

Q. Is it necessary to use an insulator in conjunction with a metal drop wire clamp on frame buildings?

A. Yes, the drop wire clamps should be insulated from wood buildings, using an S type knob. On masonry buildings an ordinary metal hook is satisfactory. This requirement is brought about by the Underwriters rules rather than the need for insulation of the drop wire.

Q. What size cable terminal is most suitable for cable plant?

A. A 15 pr. terminal is most flexible and the larger companies use this size terminal almost exclusively. It permits a superior multiplying arrangement to that obtainable with ten pair terminals.

Q. What length poles should be used on one arm leads where tree and ground clearances are not determining factors?

A. 16 ft. poles are adequate in rural areas where only a few crossings are encountered. At all crossing points it will of course be necessary to grade the line up to give adequate clearance over the crossing.

Q. Where several cables run through a manhole from the entering duct systems, is it necessary to bond them together?

A. Yes, all of the cables should be bonded together with regular bonding ribbon. This serves to equalize and prevent differences of potential from existing between several cables.

Testing

Q. What is the correct test for telephone dry cells used in rural telephones?

A. Telephone dry cells should be replaced when they show less than 0.93 volt across a 5 ohm load. A satisfactory dry cell tester can be made using any 3 volt voltmeter across the terminals of which is placed a 5 ohm resistance.

Q. Of what use are the so-called "Megger Instruments" in the telephone field?

A. These are ohmmeters capable of reading resistance leakage and are used to test the insulation resistance of telephone cable. Similar instruments are also used for measuring the resistance of substation or C. O. grounds.

Q. In making a Wheatstone Bridge fault location measurement on a wet cable we used the three Varley method and our two good wires were a copper toll line paralleling the cable. With the ratio arm set on 1.0 we were unable to get the bridge to balance, i. e., regardless of what value resistance we cut into the R arm, it would still show a negative deflection. What is the reason for this and how could it have been corrected?

A. Your difficulty resulted from the fact that your good wire No. one resistance was considerably less than the resistance of the bad wire, hence with a ratio dial setting of 1 to 1 you could not possibly balance the bridge as the X arm, consisting of good wire No. 1 (the open wire conductor) would have considerably less resistance than the bad wire (the cable conductor).

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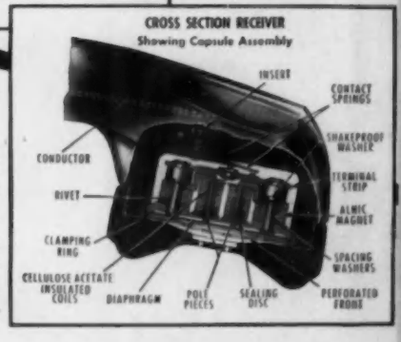
Conversation can be easily carried on after slight practice, and with occasional repetition of a word or sentence. On first listening to the Telephone, though the sound is perfectly audible, the articulation seems to be indistinct; but after a few trials, the ears become accustomed to the peculiar sound and find little difficulty in understanding the words.

The Stromberg-Carlson Transmitter

Although employing the capsule type of assembly, the transmitter used in the new No. 1222 Stromberg-Carlson Handset telephones is similar to the widely-accepted transmitter the Company has used for the past few years. It employs the cone-shaped diaphragm of the radio speaker. Its center moves as a rigid piston, flexing on annular corrugations near the outer edge.



The Stromberg-Carlson Receiver

All-round performance is provided by this new capsule receiver. It gives unusually high clarity of reception, eliminates all sharp resonances, and offers high resistance to the deteriorating effect of humid climates. These characteristics are the results of painstaking selection of materials, correct design, and progressive engineering.

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Cross-talk Theory

This article fourth of a series, discusses the theory of cross-talk and explains the effect of wire spacing, configuration and pin positions.

IN the two preceeding articles we presented and discussed tables showing the cross-talk between both physical and phantom circuits. In order to make these tables of greater benefit to Engineers, we will in this article explain the principles involved in cross-talk.

The first question which arises in discussing this subject is "What causes interference known as cross-talk?" Perhaps we should first explain what cross-talk is. We generally think of cross-talk as the interfering effect in one telephone circuit from voice energy in another circuit generally adjacent thereto or in the immediate proximity on the pole line. Before the advent of carrier systems, cross-talk was intelligible interference. In other words one party could hear conversations going on over other telephone circuits. Cross-talk at carrier frequencies refers to energy in one circuit resulting from telephone conversations on other carrier circuits. This may be either intelligible or unintelligible depending on the frequencies involved. Cross-talk in the form of interrupted whistles may also occur on carrier telephone circuits due to operation of carrier telegraph. Conversely we may have interference on carrier telegraph channels from carrier telephone circuits or other telegraph channels.

The first attempt to measure the interfering effect known as cross-talk used a buzzer type tone applied to one circuit and a listening test made with a telephone receiver on the interferred circuit. The magnitude of cross-talk was measured by comparing the tone on the interfered circuit with that from the same source but attenuated by means of a variable network. The procedure consisted of applying the tone to the one circuit and listening to the interference on the other in the receiver. Then the receiver was disconnected from the telephone circuit and connected to the tone source through a potentiometer calibrated in cross-talk units. In making the tests the distant ends of both the interfering and interfered circuits were terminated in their characteristic impedance, i. e. 600 ohms for non-loading open wire circuits. The cross-talk scale was based on the ratio between currents flowing in interfering and interfered circuits. An arbitrary standard was adopted whereby if the current delivered to the interfering circuit was 100 MA and the current in the interfered circuit was 1 MA, the cross-talk was 10,000 units. If the current in the interfered circuit was .1 MA the cross-talk was 1,000 units and if the current was .01 MA the cross-talk was 100 units.

The method devised was quite accurate, however some experience was necessary for a test man to obtain consistent results as a comparison by ear was used in the measurement. The tone was a complex frequency wave having characteristics similar to voice therefore if the cross-talk was high when using the tone test it was safe to assume that the voice interference would also be high.

With the advent of carrier systems the original cross-talk meter was unsatisfactory as it was suitable only for frequencies in the voice range. Carrier frequency cross-talk could best be measured using single frequencies and as the transmission unit (Decibel) was now in common use it became readily adapted to measurements of cross-talk. Inasmuch as there was a definite relation between the decibel equivalent and cross talk, the conversion from one method to the other was relatively simple. The formula for converting cross-talk units to DB is:

$$\text{Cross-talk in DB} = 20 \log \left(\frac{\text{Cross-talk Units}}{1{,}000{,}000} \right)$$

The use of a DB meter to measure cross-talk is much better than the original method as the indication is positive and not subject to human error; however, the ordinary DB meter does not have sufficient sensitivity to

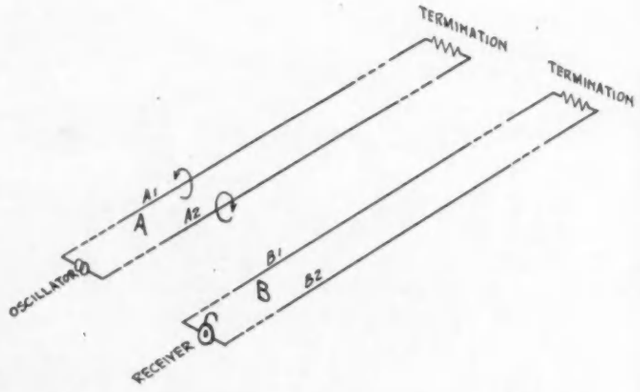

Fig. 1 — Inductive Coupling.

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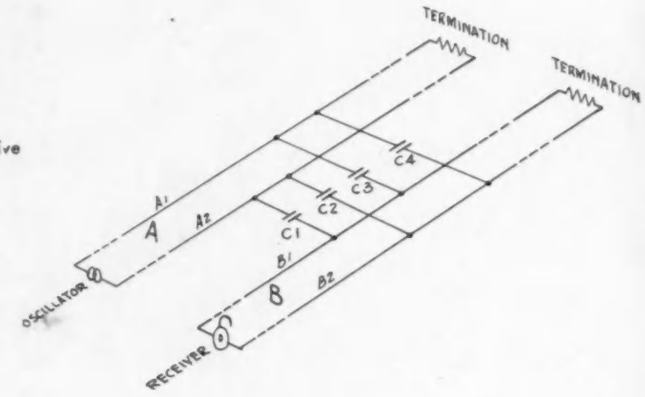

Fig. 2 — Capacitive Coupling.

measure cross-talk, but by using a one or two stage amplifier ahead of the meter, satisfactory readings can be readily obtained. The source of energy may be any of the various multi-frequency oscillators such as the beat frequency type having the proper output impedance. In making voice frequency measurements at least ten frequencies should be employed starting at about 300 cycles and continuing up to 2,000. Carrier frequency measurements should obviously be made at the frequencies in question. When making measurements care should be taken that the distant terminals of both circuits involved terminated in the characteristic impedance of the line.

You may ask what causes cross-talk and what factors effect its magnitude. There are two phenomena which determine the cross-talk between two circuits. One is the magnetic coupling, the other is the capacitive coupling. Both are of about equal importance and fortunately the measure taken to reduce the effect of the former will also reduce the effect of the latter. Fig. 1 illustrates the inductive relation between two circuits A and B. Assume that we have a generator connected to circuit A and a telephone receiver connected to circuit B. Energy from the oscillator flows down along the line to the resistance termination at the distant end of the circuit. This sets up a magnetic field around the wires of circuit A which extends over and cuts the wires of circuit B. Inasmuch as wire A2 is closer to wire B1 than it is to wire B2 a difference of potential will exist between B1 and B2 which causes current to flow in circuit B. This voltage is partially neutralized by the induced voltage due to current flowing in wire A1 which is of opposite polarity, however as wire A1 is further away its effect is not as great as that from A2, a potential still remains between wires B1 and B2.

You may ask how can this effect be minimized. It is quite obvious that if we move circuit B further away from A there will be less voltage induced. We can also reduce the voltage between the wires of circuit B by moving them closer together. This is also apparent as we can see that there would be no difference at all if wire B2 was exactly the same distance away from A2 as wire B1. Reducing the separation between the wires of circuit A. will also reduce the cross-talk because the voltage at B1 would approach the same magnitude from both A1 and A2 but of opposite polarity. **Inasmuch as the field is of opposite direction the resultant would be a cancellation and therefore no voltage induced.**

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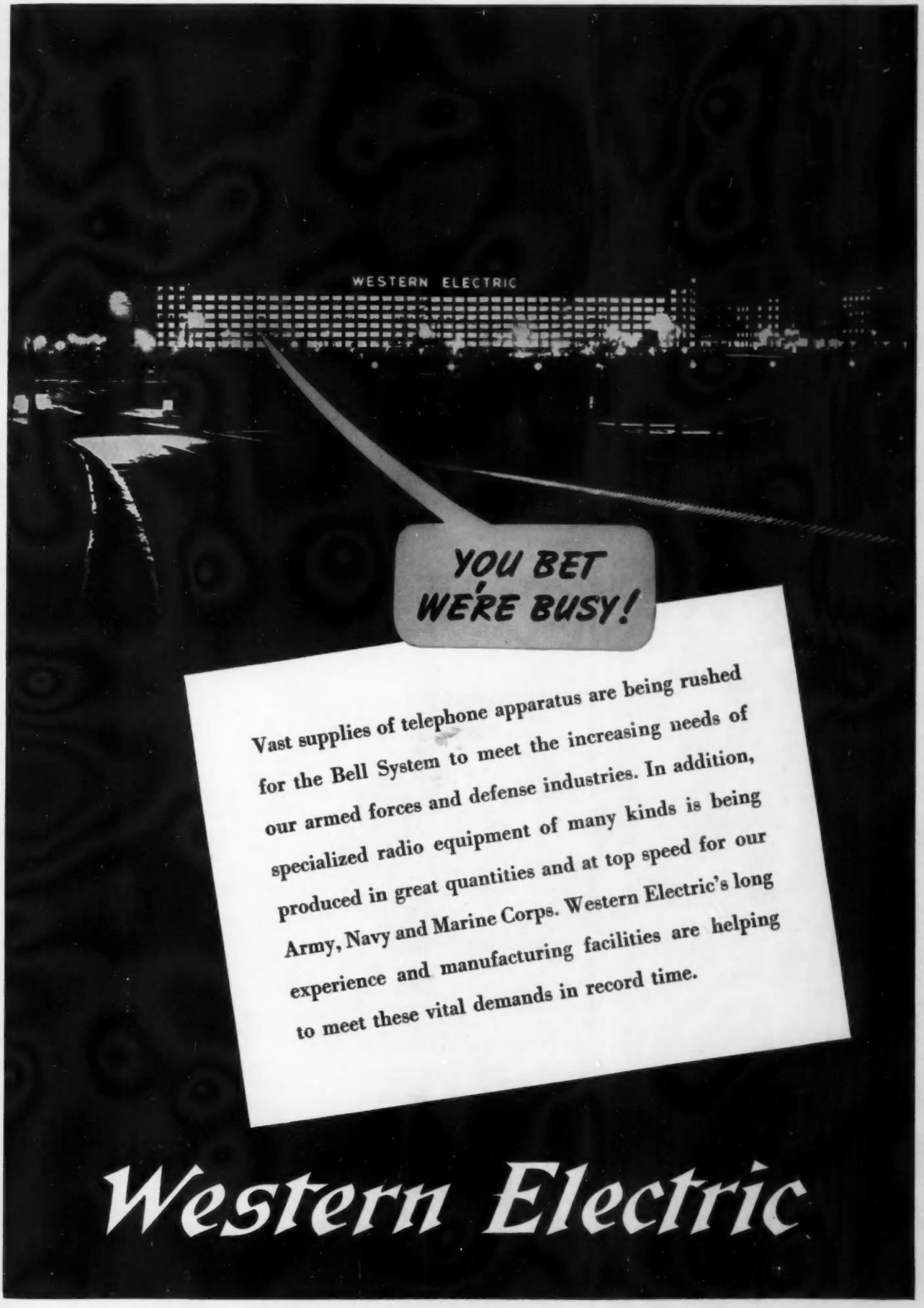

Vast supplies of telephone apparatus are being rushed for the Bell System to meet the increasing needs of our armed forces and defense industries. In addition, specialized radio equipment of many kinds is being produced in great quantities and at top speed for our Army, Navy and Marine Corps. Western Electric's long experience and manufacturing facilities are helping to meet these vital demands in record time.

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capacitive induction between the two circuits as shown in Fig. 2. Referring to this figure you will see four equivalent condensers which represent the coupling between the four wires. If these were all alike there would be no cross-talk, however the capacity between the wires is a function of the distance between them and therefore no two of the condensers are alike. As mentioned previously the same space factors effect capacitive coupling as effect the inductive coupling. For example if we space wires A1 and A2 close together, C3 and C4 will approach the same value. Likewise C1 and C2 will approach the same value if wires B1 and B2 are close together.

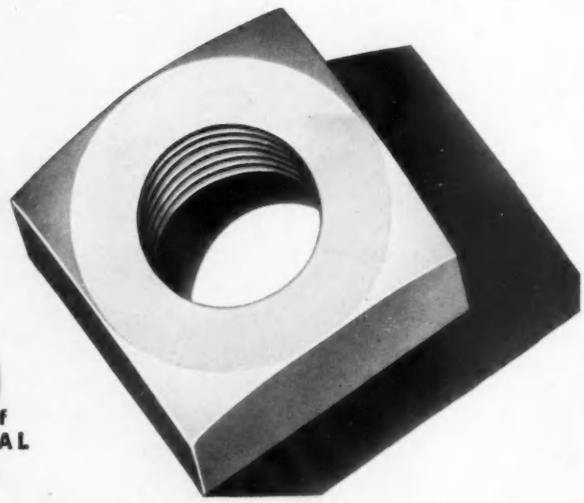
The cross-talk will obviously decrease if we make C1, C2, C3 and C4 very small, therefore by increasing the separation between the circuits the cross-talk will decrease. Another factor which tends to mitigate capacitive coupling is the shielding effect of wires which may be between the two circuits in question. In other words the presence of wires, 3, 4, 5, 6, 7 and 8 would appreciably reduce the capacity between wire 1-2 and 9-10. The exact shielding effect is somewhat difficult to compute and will depend somewhat on the type of circuits involved. Having in mind the phenomena discussed above you will be able to see the reason for differences in cross-talk between pairs on a telephone line as shown in Table 1 of the October article. In the next issue we will discuss these tables more in detail and bring out various uses in practical problems.

Quantitative Design of Central Office Equipment

(Continued from page 24)

by releasing the connecting cord equipment for use on succeeding calls. It is, of course, possible and highly desirable that the average conversation time and the average holding time be ascertained through a large number of timed observations by listening on actual conversations and this is the universal practice in larger offices. Experience, however, has provided satisfactory and conservative general figures which may safely be applied, in the absence of data based on actual observation, in small offices. These general average figures are those which are suggested above.

Where data is available as to the total number of originating calls handled per day and the total number of originating calls handled during the "busy hour" it is comparatively simple to determine the number of connecting cord pairs that must be provided. It should be remembered also that on any basis whatsoever of average conversation time, average "busy hour" traffic and total number of subscribers' lines that the relative magnitude of the peak traffic load in originating calls for short periods, such as three minutes, is much greater in comparison with the total "busy hour" load in originating calls in small groups of telephone lines than it is in large groups. Reduced to practical wording, for illustration, this merely means that a larger **proportion of the total** number of "busy hour" calls will be in existence during some period of three minutes in the hour when a total of fifty subscribers' lines is involved than would be the case if a total of five hundred subscribers' lines were involved. It is also true that the number of calls in existence during a part of the "busy hour," in any group of telephone lines, is greater, so far as the provision of connecting cord circuits in manual offices is concerned, than would be indicated by the proportional length of the partial hour period in question. Reduced to practical wording this means, for illustration, that **fifty-six** percent of the total "busy hour" calls will be in existence during thirty minutes which is **fifty** per cent of the "busy hour" in time. In a similar way, about **twenty-one** per cent of the total "busy hour" calls will be in existence during ten minutes of the "busy hour" although ten minutes is only sixteen and two-third per cent of the hour. This is graphically shown by the curve in Fig. 2. The point is that a greater number of connecting cord circuits must be provided in the Magneto Office than would be indicated by dividing the total hour of sixty minutes by the length of time during which each of the connecting cord circuits is engaged on one call is three minutes, which is **five** per cent of one hour, then sufficient cord circuits should be provided, in any group of telephone circuits, to handle about six and one-half per cent of the "busy hour" originating traffic occurring in that group. It is a characteristic of telephone traffic that the direct proportion as pointed out does not hold true. The length of conversation time can, in the author's opinion, only be determined by direct observation and timing of completed subscribers' calls and while it is believed that the average length of telephone conversations in large metropolitan centers



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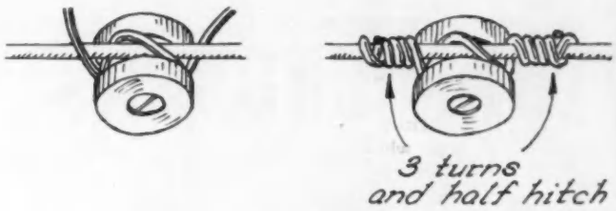
is less than the average length of telephone conversations in smaller centers, there is no substitute for actual observation and timing. It is because the amount of equipment involved is relatively small, however, that in the small Magneto Offices a safe average outside figure for connecting cord holding time may be assumed. It is obvious that any assumption of such an average holding time must be based upon considerations of the most conservative character in order to avoid danger of encountering inadequate equipment during some peak load with a resultant impairment in the standard of service.

(TO BE CONTINUED)

WIRE CHIEF'S TRAINING COURSE

(Continued from page 22)



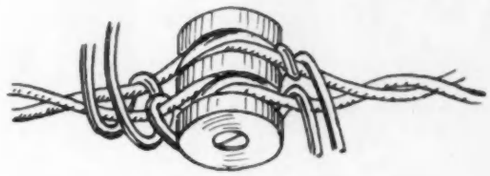


Fig. 9—Straight Tie for Parallel and Twisted Pair.

Where porcelain knobs are used with twisted pair or parallel drop wire and where hand ties rather than special clamps are used, the porcelain knob may be attached directly to the side of the pole using a short galvanized screw, or a galvanized **pole bracket** may be used. The pole bracket is desirable where several insulators can be supported by one bracket as shown in Fig. 4.

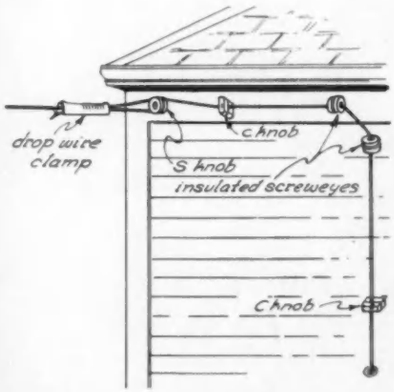


Fig. 8—Typical Drop Wire Installation on Frame Building.

Where drop wire clamps are used to hold the dead end strain at the pole a simple galvanized hook as a support for the clamp is all that is required. When twisted pair drop wire is supported with clamps the wire should be untwisted and laid parallel where it runs through the clamp.

Dead End Hand Ties

FIGURE 5 and 6 shows how hand tie dead ends are made in both parallel and twisted pair drop wire.

It is important that the ties be correctly made as otherwise the tension may cause the tie to cut through the drop wire insulation resulting in a case of trouble. The loop which is formed at the deadend is helpful in preventing crystallization of the wire at the point where it breaks away from the tie.

Supports on Buildings

AT the building end of a drop either an **angle screw** or a **house bracket** is ordinarily required to support the porcelain knob. It is of course possible

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to place the knob at the corner of the building in such a way as to have the pull in line with the knob and not at an angle to it. However, except where this is possible, a house bracket or angle screw will be required. The use of drop wire clamps avoid the necessity for an insulator only on brick or stone buildings, where a simple hook is all that is required.

It should be noted that drop wire clamps must be insulated from frame buildings, but need not be insulated on brick buildings.

All drop wire run on buildings should be run horizontally or vertically and never diagonally across the side of the building. The ideal installation is to have the dead end support on the same wall as the point of entrance and preferably directly above the point at which the drop enters the building. This reduces the drop wiring run on the building and necessitates merely a vertical downward run from the drop wire support to the point of entrance which is usually through the sill into the basement of the building. Figure 8 illustrates a typical drop installation on a frame building.

Where long horizontal and vertical runs are required, intermediate supports must be used. If a twisted pair wire is involved the self-tying knob previously referred to works out nicely. An intermediate or **straight tie** as it is usually called is shown in Figure 9 for both parallel and twisted pair drop wire.

Where drop wire makes a 90° turn in a wiring run the **corner tie** should be used. Figure 10 illustrates corner ties suitable for both parallel and twisted pair wire. A split knob suitable for an intermediate support with parallel wire is shown in Figure 8 and should be used where possible as it makes a much neater installation than

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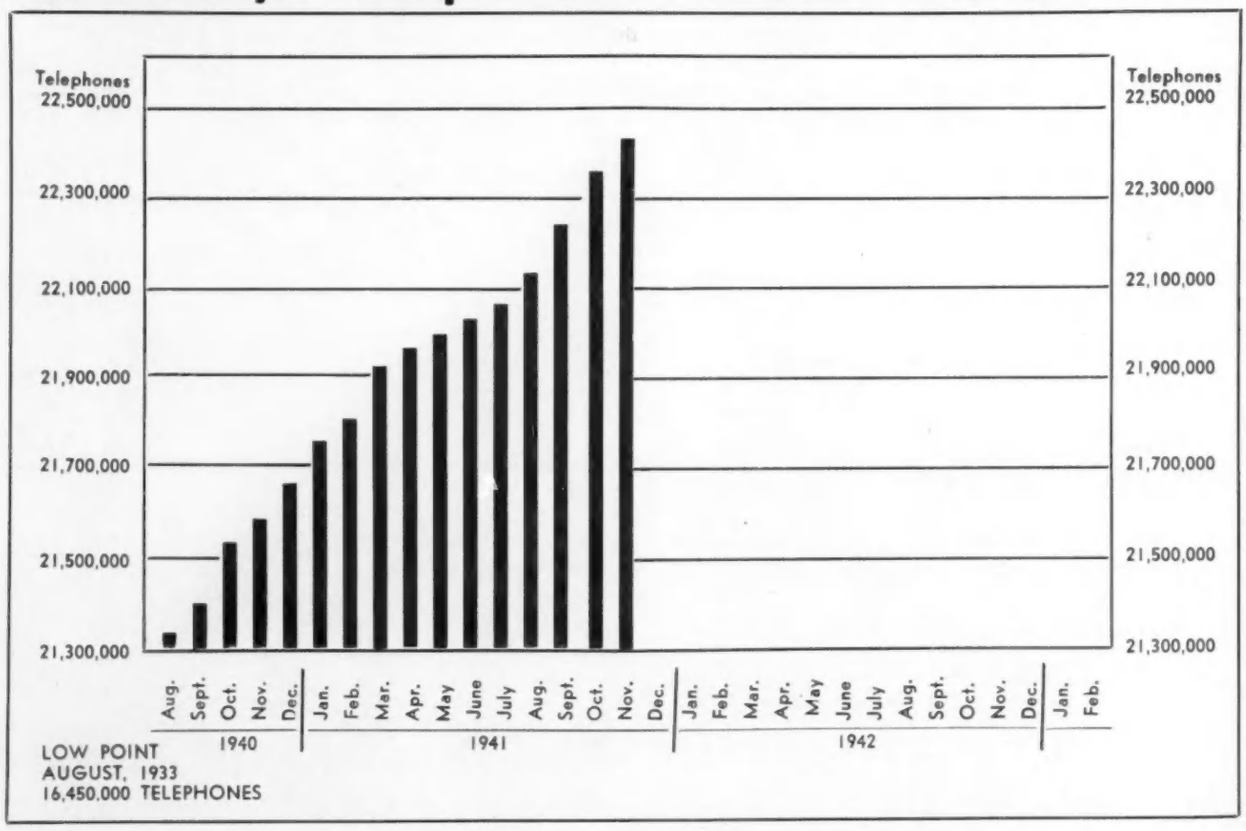

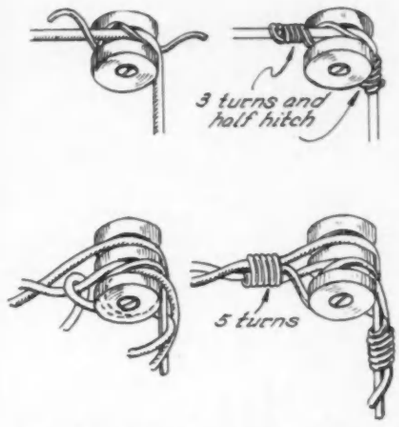

Fig. 10—Method of Making Corner Ties.

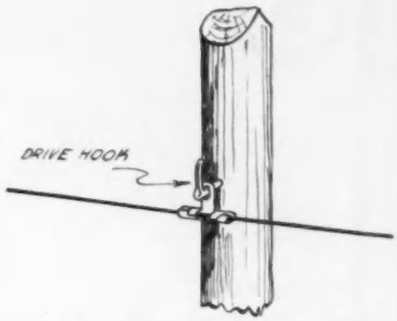

Fig. 11—Use of Drop Wire Clip.

where a tie is used.

For supporting parallel or twisted pair drop wire at an intermediate point in a several span run on poles, a **drop wire clip** as shown in Fig. 11 is convenient and permissible.

Oftentimes due to some intervening obstruction such as buildings or trees, it is impossible to have the drop extend directly from the pole to the building to be served. In such cases and where the drop feeds from the pole line carrying cable, the drop may be carried out along the cable supporting strand and fed from some convenient point in the span by means of a messenger clamp which holds a drop wire insulator or drop wire clamp. Figure 12 illustrates the use of this type of device.

Drop Wire Splicing

SPLICES in drop wire runs should be avoided where possible. Ordinarily in any installation the drop wire can be extended from the pole to the building and into the lightning arrester without requiring any splices. If in stringing out drop wire from a coil it is found that there is not enough wire in the coil to complete the installation without a splice, the wire should be coiled up and returned to the warehouse and a new coil opened. Short lengths of drop wire can usually be used up on installations requiring a short drop. It is sometimes advisable to splice together drop wire which has been returned to the shop where a number of short lengths accumulate. Lengths shorter than 50 feet should not be spliced.

Splices are more apt to be required in connection with maintenance work, as for example when a drop has been broken during a storm or when rerouting is necessary. In such cases a **sleeve splice** should always be used as hand splicing is likely to cause trouble unless the splice is very carefully made and soldered. Either the double tube of (preferably) the newer single tube type sleeve should be used.

The several steps in drop wire splicing using the new suppression sleeve method are shown in Figure 13 and 14.

It should be particularly noted that the splices should be staggered so that there is a gap of approximately two inches between the two sleeves. After

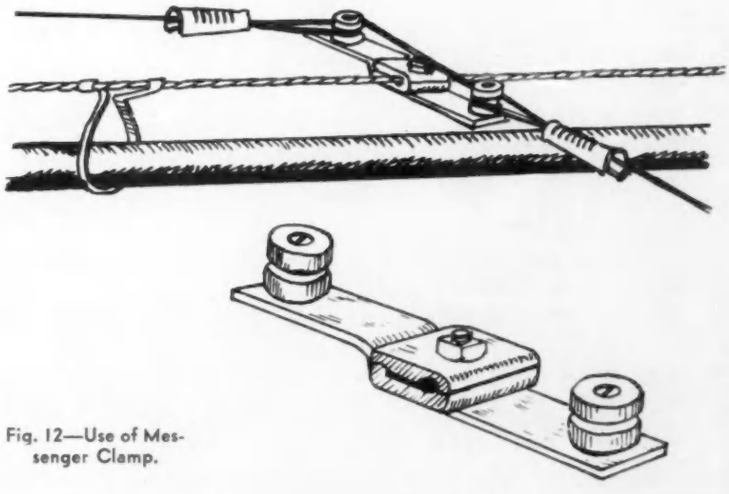

Fig. 12—Use of Messenger Clamp.

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AUTOMATIC ELECTRIC
TELEPHONE SIGNALING AND COMMUNICATION APPARATUS

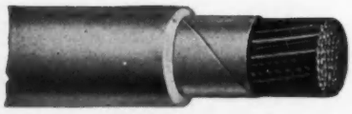
ROEBLING
ELECTRICAL WIRES AND CABLES

Telephone Cable... Paper Insulated and Leaded

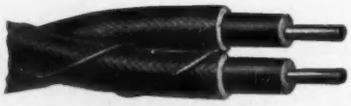
ROEBLING makes available a wide variety of electrical wires and cables to meet practically every telephone and telegraph need. In addition to those shown, Roebling makes:—Parallel Telephone Wire ...Rubber Insulated and Braided, Bare Copper and Bronze Wire, Bare Galvanized Steel Wire, Galvanized Steel Strand.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, N. J.

Branches in other cities



Telephone Switchboard Cable .... Silk and Cotton Insulated and Leaded



Twisted Pair Telephone Wire .... Rubber Insulated and Braided.

JAR

ONLY A FINE PRODUCT MAY BEAR THE NAME ROEBLING

the sleeve has been carefully made it should be covered with a double layer of ¾ in rubber tape. This is the same tape as that used in electrical wiring work and should be stretched out so that it forms a watertight joint. Two reverse layers of friction tape should then be placed over the rubber tape. Be careful that the rubber tape does not unwrap before the friction tape is applied. In splicing twisted pair wire be sure that wires are cut so as to be of equal length and so that all the strain will not come on one of the wires.

On parallel wire first remove the outer braid for 6 inches on end of each pair to be spliced.
Stagger the splice, cutting 3½ inches off one conductor of each pair. Make sure cut conductors are reversed so that when spliced the polarity of the circuit is maintained. The lengths of each conductor should match so that tension will be equal on spliced conductors.
Skin each wire back one half length of sleeve and clean with pliers or abrasive cloth.
Place sleeves on one pair, making three squeezes from end of sleeve to center.
Fit ends of other pair into sleeves and make three compressions as before, beginning at ends and working towards centers.
Shows finished splice before taping. Rubber tape is recommended for each conductor splice and friction tape over the pair.
Shows finished splice of twisted pair, drop or bridle wire before taping.

Fig. 13 & 14—The Several Steps in Drop Wire Splicing using Single Tube Sleeves (Parallel and Twisted Pair).

Length of Span	Recommended Minimum Sag
60	—2 in.
80	—7 in.
100	2 ft. 6 in.
120	4 ft. 8 in.
140	7 ft. 0 in.
160	9 ft. 6 in.
180	12 ft. 0 in.
200	16 ft. 0 in.

Table No. 3—Drop Wire Sag Table for Heavy Loading Area.

Span Lengths and Sag

IT has previously been stated that the breaking strength of drop wires is considerably less than that of open wire conductors used in outside plant construction. Because of this as well as the fact that due to the shape of drop wire it tends to accumulate large deposite of ice and snow, care must be taken to keep spans as short as possible and to provide adequate sag. Table No. 3 shows the sag to be given various length spans in the heavy loading area. Somewhat less sag would be required in the medium and light loading areas. Most of the larger companies limit the length of drop wire span to 200 feet.

Course Examination No. 10

DROP WIRE CONSTRUCTION

1. What is one of the primary causes of excessive drop wire maintenance and short life?
2. Give the code clearance for a drop wire crossing over (1) railroad tracks and (2) private driveways.
3. What is the total breaking strength of No. 17 bronze drop wire?
4. What is the advantage of drop wire clamps over hand ties?
5. What precaution should be taken when using a twisted pair drop wire with drop wire clamps?
6. What is the purpose of the loop sometimes placed in a hand tie deadened?
7. Is it necessary to insulate a drop wire clamp at the point when it attaches to a frame building?
8. What type of porcelain knob is suitable as an intermediate support for parallel wire on a frame building?
9. Explain the purpose of a messenger span clamp.
10. How much sag should be given a 100 ft. span of drop wire in the heavy loading district?

Personals

(Continued from page 29)

success of the district meeting held this Fall by that Association. Mr. Achatz was present at these meetings and led the discussions.

•

Dana Coleman, manager of the United Telephone Company, Marysville, O. has anounced launching of construction of a new and modern telephone exchange building at Raymond, O. Completion is expected in six weeks.

•

Congratulation to **Mr. and Mrs. Albert H. Pogge,** manager of the Iowa Telephone exchange at Riverside, Ia. who celebrated their silver anniversary in November.

•

Elmer L. Jones, 69, manager of the Glouster (0.) Telephone Company for 40 years, died recently in a hospital at Columbus, O.

•

E. R. Hannibal, general manager of the West Coast Telephone Co., Everett, Wash., gets the palm this month on his writings in that company's November magazine, Crosstalk. His page on experiences in World War I and his reminiscenses of the Armistice are worth the reading.

•

James C. Poole, general manager of the Ohio Central Telephone Corporation, Wooster, O., recently retired as 45 years of active service in the industry. He hopes to improve his health by means of an extended rest.

•

George Butler, secretary of the Texas Telephone Association writes the editor the dates of the Texas convention for 1942 and adds as a P. S. "Wish Texas Christian University would join another conference." George is a Texas University Man and myself and brother Roy are former quarterbacks at T. C. U. We thought you could have heard us down there in Texas, George, when we listened to the broadcast that kept Texas out of the Rose Bowl.

Station Gain

There was a gain of about 102,100 telephones in service in the principal telephone subsidiaries of the American Telephone and Telegraph Company included in the Bell System during the month of November, 1941.

The gain for the previous month was 120,900 and for November, 1940, 90,500. The net gain for eleven months this year totals 1,230,900 as against 838,700 for the same period in 1940. At the end of November this year there were about 18,712,100 telephones in the Bell System.

Cook Electric's New Advertising Slogan

"New for 1942" is a slogan with which the Cook Electric Company has launched its current advertising program. It is understood that a parade of new products will be described in the company's advertisements appearing during the coming month, some of which were displayed at the national convention.

The "New for 1942" slogan and identification mark will call attention to products embodying the latest technical developments in the telephone protection field, thus enabling plant men to study the new features and determine upon their application to the operating company's protection problems.

Beam Joins Hirsch Organization

Arthur Beam has resigned his positions as wire chief with the Celina Telephone Company to accept employment with the Gustav Hirsch organization of Columbus.

Up-to-the-Minute PRINTED FORMS

For Telephone Companies

New forms of—

RENTAL BILL
TOLL STATEMENT
SUBSC. RECORD

These new forms make it easier for you to handle the new tax billing problems.

Write for samples.

Order all your printing from Suttle right along with your other supplies and equipment. One order to write up and one bill to pay.

SUTTLE EQUIPMENT COMPANY
LAWRENCEVILLE, ILLINOIS

It's "GRAY-vy"

Money earned by Gray Pay Stations is largely extra revenue because they turn those non-paying, bothersome "Mind - if - I - use - your - telephone?" borrowers into cash customers.

GRAY PAY STATIONS

DISTRIBUTED BY

AMERICAN
AUTOMATIC ELECTRIC
SALES COMPANY

1033 WEST VAN BUREN STREET · CHICAGO, ILLINOIS
BRANCH WAREHOUSES AT DALLAS, KANSAS CITY, LOS ANGELES, RICHMOND (VA.) AND SAN FRANCISCO

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NATIONAL DEFENSE

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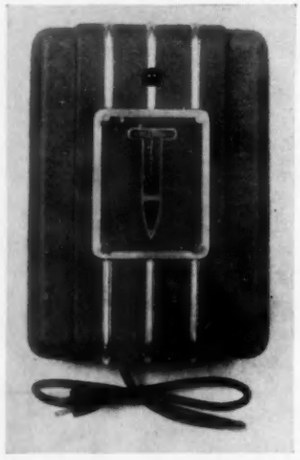
has

PRIORITY

While "all-out" National Defense co-operation is taxing our production facilities — We are proud we have been able to continue to make satisfactory deliveries to our government and to our customers in the telephone field.

TELERING

Reliable ringing service is essential in providing satisfactory telephone service.



Directly converts Commercial Alternating Current to Telephone Ringing Current—Current Consumption Negligible—Positively NO radio interference.

Use TELERING and provide the MOST reliable service at the LEAST cost.

Order through your jobber or direct from

TELKOR, Inc.
ELYRIA, OHIO

Employees Committee of the Denver and Ephrata Telephone Co. at their Annual Meeting at Lititz, Pa.

Celebrates 30th Anniversary

THE Denver & Ephrata Tel. & Tel. Co. celebrated its 30th Anniversary and the installation of its 5000th telephone at a banquet at the General Sutter Hotel Lititz, Penn., November 12, 1941.

Wm. F. Brossman, President since the company's organization in 1911 also celebrated his birthday, and was presented with a large basket of roses and crysanthemums by J. Harry Hibshman, President of the Ephrata National Bank in honor of the occasion. Mr. C. E. Eaby, Vice President and General Manager served as Toast Master and called upon H. Frank Eshleman, Solicitor for the company since it started, who presented, in behalf of the Board of Directors a book containing a history of the company. To Mr. Brossman Wayne L. Fair, in behalf of the 75 employees who attended, presented a similiar gift to Mr. Eaby in recognition of his thirty years of service as Vice President and General Manager. Bertha M. Brossman, Assistant Secretary and Treasurer of the company introduced the employees in a unique composition of her own originality. Miss Brossman also introduced C. E. Eaby's two brothers, Mark and Paul Eaby, and mentioned that the three brothers have a combined service record of 106 years in the Telephone Industry.

Service Pins and buttons were presented by Bertha M. Brossman to the following employees who had fifteen years of service with the company.

Anna Bollinger, Verna Forney, Grace Keppel, Janet Rudy, Miriam Weidler, Harry Felker, Charles Gerfin, Sylvester Royer, G. Lester White.

A diamond studded service pin was presented to Mrs. Mary Greeninger in honor of her long service record. Monroe Lausch, Secretary, presented Mr. Eaby with a thirty year service button. Thirty year service buttons were also presented to Wm. F. Brossman, and H. Frank Eshleman by C. E. Eaby.

In attendance were two retired employees of the Denver & Ephrata Tel. & Tel. Co., Mrs. Mary Greeninger, and Miss Grace Keller, both of whom have

"Cope"

It's the name behind the Product that counts

AERIAL EQUIPMENT

CABLE HANGERS
AERIAL FEEDERS
SLACK PULLERS
PULLING SWIVELS
COMPOUND KETTLES

For a period of over fifty years "COPE" has stood for quality in workmanship and design. We have pioneered many of the features in cable installation equipment which today have become standard in most of the principal Telephone Companies, Central Stations and Municipal Plants throughout the country.

WRITE FOR CATALOG

T. J. COPE, INC.
6120-6122 VINE STREET
PHILADELPHIA, PA.

The speakers' table at the anniversary dinner: (L. to R.) H. Frank Eshleman, Monroe Lausch, Wm. F. Brossman, C. E. Eaby, Bertha M. Brossman. D. W. Buch was unable to attend.

outstanding service records. Other guests were: Mr. and Mrs. H. Milton Stewart, Albert Herbert, Mrs. G. S. Herbert, Lane Hart, Myrna Speas, Mr. & Mrs. C. A. Carl, G. C. Meckel, Mr. & Mrs. W. A. Pancky, of Harrisburg; W. W. Ponsford, Philadelphia; Mr. & Geo. Hoffman, Mr. and Mrs. Theodore Hopkins, Mr. & Mrs. H. L. Shober and Kay Shober, Mr. & Mrs. Frank Gendall of Reading; Mr. and Mrs. H. L. Wigham, Kathryn Wendel, Mr. & Mrs. Paul Eaby, Mr. & Mrs. Mark Eaby, Mr. & Mrs. H. Frank Eshleman of Lancaster; Mr. & Mrs. John Gehr, Mr. & Mrs. John H. Martin of New Holland; H. M. Stauffer, Leola; Harry E. Miller, Herman Himmelberger, Myerstown, John K. Stoltzfus, G. F. Handwork of Birdsboro; Henry Smith, Columbia; J. Harry Hibshman, Fred Smith, H. S. Royer, Emily Brossman, Theodore R. Sprecher, Ephrata; Monroe Lausch, Denver.

The committee representing the 75 employees who attended were: C. E. Powell, W. L. Fair, John Gochenaur, Fern Brossman, Mary Hornberger, Miriam Weidler, Catharine McCloud.

An entertainment program was presented by Professor Theodore H. Sprecher, who gave several piano solos, Emily Brossman rendered a vocal solo and Master Kay Shober gave several tap dancing selections.

Souvenirs were presented to every one present. Door prizes were won by John Weller, Catharine Leibensperger, and Harry Dickersheid.

UNINTERRUPTED SERVICE

with Non-Grounding Rare Gas Arresters

Used for many years by leading Railroads for vital Telephone, Telegraph and Signal Circuits.

Type MCD (illustrated) interchangeable with your present carbon block protectors.

Write for Catalog 39-A describing
Arresters Anti-Noise Relays
Terminal Strips Potheads Housings

L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N. J.
Signal Circuit Engineers Since 1906

ARMORED AGAINST THE ATTACKS OF

TERMITES

"Black Beauty" Poles are thoroughly treated with creosote to safeguard them from the assaults of termites and other wood-boring insects.

You can depend on

"BLACK BEAUTY" POLES

PRODUCT OF TEXAS CREOSOTING COMPANY

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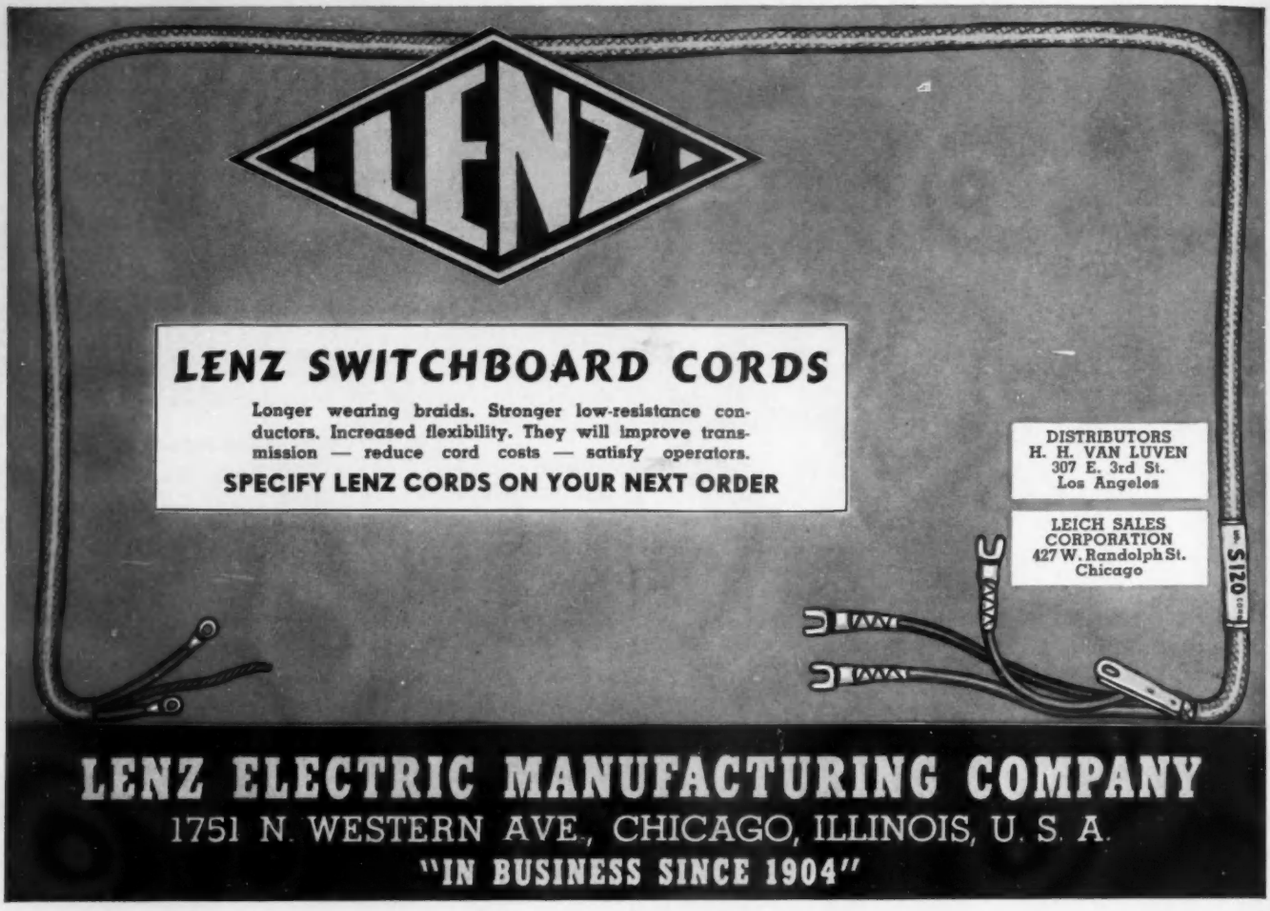
BRANCH WAREHOUSES AT DALLAS, KANSAS CITY, LOS ANGELES, RICHMOND (VA.) AND SAN FRANCISCO

It's What's Inside That Counts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LENZ SWITCHBOARD CORDS
Longer wearing braids. Stronger low-resistance conductors. Increased flexibility. They will improve transmission — reduce cord costs — satisfy operators.
SPECIFY LENZ CORDS ON YOUR NEXT ORDER
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LENZ ELECTRIC MANUFACTURING COMPANY
1751 N. WESTERN AVE., CHICAGO, ILLINOIS, U. S. A.
"IN BUSINESS SINCE 1904"

Telephone Engineer

HANDBOOK TABLES

By B. C. Burden

File — General Data
Date—Dec. 15, 1941

Subject—CURRENT CAPACITY OF COPPER WIRE AND FULL LOAD MOTOR CURRENT

General:

The maximum current that should be passed through copper wire is fixed by the National Electric Code and is higher for varnished cambric insulation than for rubber and is as shown in Table No. 1. The amount of current a motor draws from a line depends on the mechanical load. Full load current for different size motors is given in Table No. 2.

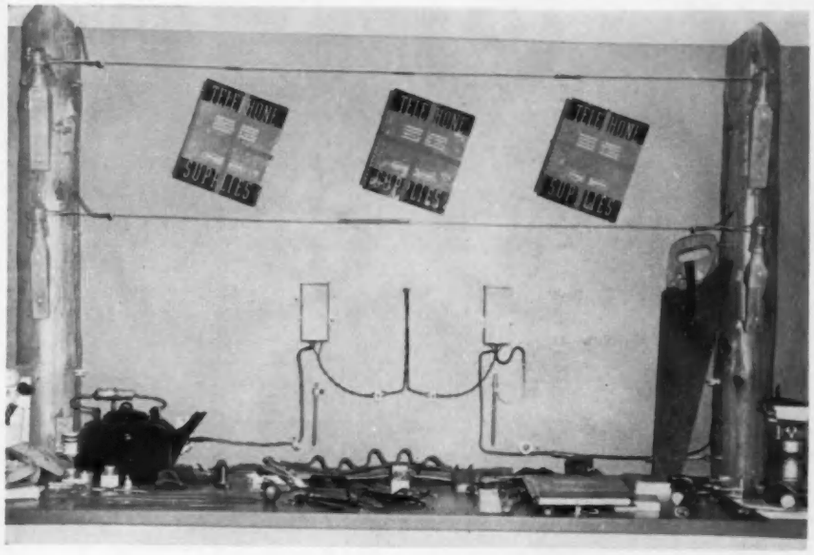
TABLE NO. 1—CURRENT CAPACITY OF COPPER WIRES

Gage No.	Diameter of Solid Wires in Mils	Rubber Insulation Amperes	Varnished Cambric Insulation Amperes	Other Insulation Amperes
18	40.3	3	—	6
16	50.8	6	—	10
14	64.1	15	18	20
12	80.8	20	25	30
10	101.9	25	30	35
8	128.5	35	40	50
6	162.0	50	60	70
4	204.3	70	85	90
2	257.6	90	110	125
1	289.3	100	120	150
0	325.0	125	150	200
00	364.8	150	180	225
000	409.6	175	210	275
0000	460.0	225	270	325

TABLE NO. 2—FULL LOAD MOTOR CURRENT RATINGS

H. P.	Single Phase 110 V.	Single Phase 220 V.	Three Phase 220 V.	Three Phase 440 V.
1/6	3.34	1.67	—	—
¼	4.8	2.4	—	—
½	7.	3.5	2.5	1.3
¾	9.4	4.7	2.8	1.4
1	11	5.5	3.3	1.7
1½	15.2	7.6	4.7	2.4
2	20	10.	6	3
3	28	14	9	4.5
5	46	23	15	7.5
7½	68	34	22	11
10	86	43	27	14
15	—	—	38	19
20	—	—	52	26
25	—	—	64	32

Automatic Electric at the National Convention



American Automatic Electric Sales Company displayed, as above, pole line hardware and supplies at the recent National Convention.

IN recognition of the importance of maintaining deliveries to Independent customers in the face of increasing defense production, Automatic Electric's exhibit at the recent national convention concentrated on items which required no special diversion of manufacturing effort.

One room was devoted to the display of rebuilt telephone equipment. The theme of this exhibit was to show operating companies how to save money in meeting their emergency demands and at the same time help conserve critical materials for America's defense effort by taking old equipment now standing idle on shelves or stored away in stockrooms, and rebuilding it in accordance with Autelco Rebuilt standards. Visitors were told how old equipment can be exchanged for rebuilt apparatus, and also how rebuilt equipment can be purchased from large stocks at considerable savings when no old equipment is available for trade-in.

Another room contained a revolving pyramid display of the latest types of desk and wall Monophones in attractive colors. Two Monophones in this room were connected to a Strowger step-by-step switching unit to demonstrate the lightning-fast action of Automatic Electric dial telephone equipment.

Telephone supplies and Sands protection equipment were on display in another room, and here was presented for the first time the company's new and enlarged supply catalog. Cleverly indexed and divided into handy sections, this new book brought praise from ev-

Let

SUB-CYCLE

The MASTER Ringing Converter

Safeguard Your Ringing Service

Output Capacities 7½ watts to 40/50 watts

No Moving Parts
Nothing to Adjust
Economical Operation
Quiet

Six Models for Loads Ranging from the Small PBX to the Large Central Office.

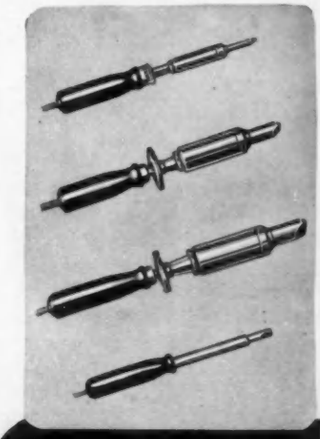
Also Pulsators

Exclusive Features.

Facts about Sub-Cycle are yours for the asking.

Lorain Products Corporation
Lorain, Ohio
Sold by Leading Distributors

THERE'S AN "ELEMENT OF SUPERIORITY" IN... "American Beauty" Irons



It's the element that makes a soldering iron and American Beauty elements are famous for long life and dependable operation.

Whether a soldering job is large or small, delicate or tough, American Beauty performance leaves nothing to be desired. Order American Beauty today!

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Western Elec. 3 Cell metal battery Boxes @	$ .50
Kellogg No. 75 Steel 1000 ohm Extension Bells with 2½ inch gongs @	2.50
Kellogg No. 41 Receivers with New Shell and cord @	1.25
Western Elec. No. 20 Desk set with New Cabinet 4-bar 1000 or 1600 ohm ringer inside connection signal set @ $11.00 5-bar @	12.00
Stromberg Carlson No. 988 or No. 992 desk set with 3-bar 1000 or 1600 ohm ringer inside connection signal set @ $9.00—4-bar $9.75—5-bar @	11.00
Kellogg No. 729 S.A. Straight Line C. B. Oak wood hotel sets with booster Coil @	6.75
Western Elec. No. 295A Wood C. B. Straight line Hotel sets with Booster Coil @	6.25
Kellogg No. 16A Talk Through repeating Coils @	1.25
Kellogg No. 2800 4-bar 1000 or 1600 ohm Bdg. Compacts @	9.25
Stromberg Carlson No. 896 5-bar 1600 ohm Bdg. Compacts @	10.75
Western Elec. No. E1B-3 hand set only with 3 Cond. Cord @	4.25
Leich Elec. Co. Transmitters with back and new Mouthpieces @	.90
Western Elec., Kellogg, S. C. or Auto Elec. 1 or 2 M. F. Condensers @	.35
Kellogg No. 22 or W. E. No. 323 Transmitters complete less back @	1.00
Western Elec. No. 1801 Sectional type C. B. PBX Swbd. with 20 lines equipped and 2 Plug ending Trunks 5-cord Ckts. Price on application.	

REBUILT ELECTRIC EQUIPMENT CO.
1934 WEST 21ST. STR.
Pilsen Station
CHICAGO, ILL.

ery visitor who examined it.

The following company representatives from out of town were present during the convention, in addition to a full representation from the Home Office. G. H. Whitley, Birmingham, Ala.; J. H. Hazlett, Los Angeles, Cal.; C. M. Sells, Galesburg. Ill.; C. W. Snyder, Ft. Wayne, Ind.; H. C. Shear, Waterloo, Iowa; J. A. White, Abilene, Kans.; P. M. Ferguson, Jr., Minneapolis, Minn.; Earl Ewer, Jefferson City, Mo.; A. C. Stratton, High Point, N. C.; J. B. Haley, Bellevue, Ohio; P. L. Picot, Mansfield, Ohio; H. L. Housley, Dallas, Texas; H. S. Dabdoub, Mexico City, Mexico.

New Product

An interesting new soldering "gadget" has recently been announced by Jiggers Inc. of 215 West Ill. St., Chicago. This device consists of a small, self-contained soldering unit that contains just the correct amount of 50-50 solder and flux hermetically sealed within a waterproof heat generating outer shell. The wire splice is pushed into the shell which is then lighted, the shell ignites and produces the proper temperature to flow the solder into the splice. The burnt shell is then dropped off and a smooth soldered splice is the result. It is claimed this eliminates the need for soldering iron or torch. Free samples can be obtained from the manufacturer.

Texas Convention To Meet in Dallas

On March 18, 19 and 20 the Texas Telephone Association will hold its annual convention at the Hotel Adolphus in Dallas, Texas. George B. Butler, secretary, promises an interesting and varied program and invites all telephone men to "join the gang" at the convention next year.

Battery Eliminators

THE NEW ELECTROX
Battery Eliminator — Type PA-05004

$16.85

Complete with power-off relay. Output for two operators' sets. Mount; connect two leads to operator's terminal; plug in cord. Presto! no more battery problem! Sent on trial. Write for Cir. 373.

ELECTROX 2060-68 Reading Road
A Schauer Product CINCINNATI, OHIO

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Write or telephone for proposition
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Call L.D. 16, Telephone Bldg., Dayton, O.

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J. G. WRAY & CO.
Telephone Engineers
Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies
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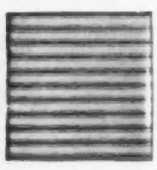
Formed-flexible finishing cloths (Patented); Flat finishing cloths; Catch cloths; Crotch cloths and Up-right joint catch cloths. Made of world-prize HERRINGBONE TICKING or imported English MOLESKIN. All-ready for use. Require no breaking-in. Ask for "Williams."



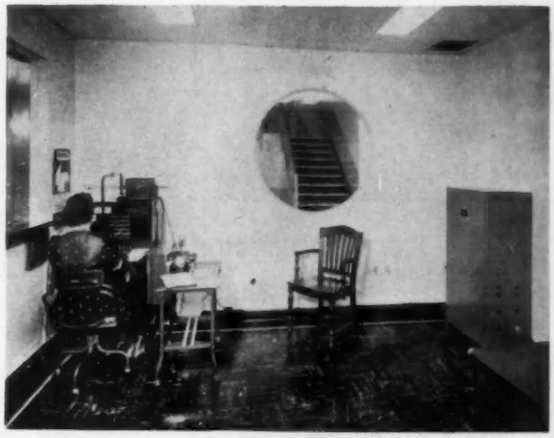
GEO. E. WILLIAMS, *Mfr.*
3035 ALDRICH AVENUE, MINNEAPOLIS, MINN.

The Clearing House

For the convenience of readers of Telephone Engineer

Switchboard Room for New Plant

In the new plant of the Charles Bruning Company, Chicago, manufacturers of sensitized papers and cloths, and of Black and White Printing and Developing Machines, the combination switchboard and receptionist's office expresses the most modern findings in functional design. The switchboard room, which houses both the public and house telephone switchboards, has a perforated metal acoustical tile ceiling.



Littelfuse Opens California Plant

The opening of a new plant at El Monte, California, signalizes the expansion of Littelfuse, Incorporated, Chicago concern internationally known manufacturer of small electrical fuses and fuse mountings for instruments, aircraft, radio, etc. The California plant supplements the Littelfuse factory at 4757 Ravenswood Avenue, Chicago, Illinois, excess demands on which have made necessary a large increase of production facilities as rapidly as possible. The California plant in fine new buildings was in full operation November 1, 1941.

Under the management of President Edward V. Sundt and Secretary-Treasurer Thomas M. Blake, the California Plant will operate in complete conjunction with the Chicago plant of Littelfuse Incorporated, serving more than 4000 manufacturers whose products require fuses.

Installing New Equipment

OZONA, TEXAS.—Arrival of part of equipment to be used in the new telephone system was announced this week by Mrs. M. A. Runnion, manager.

The system is being installed by the San Angelo Telephone Co.

Sample Tax Forms Available

Now that the telephone companies are obliged to collect from their Subscribers federal tax on toll calls and on service, and in some States a state tax too, it becomes highly important that the companies record their transactions with their Subscribers in books in which tax items are properly set up as they will be checked by the tax authorities. Books for this purpose have been arranged by the Telephone Print Company, of Napoleon, Ohio. This company has been in the telephone printing field for a long time. They will send you sample pages of these books on request.

LOOMIS
ADVERTISING CO.

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Repair service for Transmitters, Receivers, Desk Stands and Wall Phones—Magneto or Common Battery.

WE BUY
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WE REBUILD

Old telephones or parts into smart modern-looking wall phones or desk sets with new cabinets.

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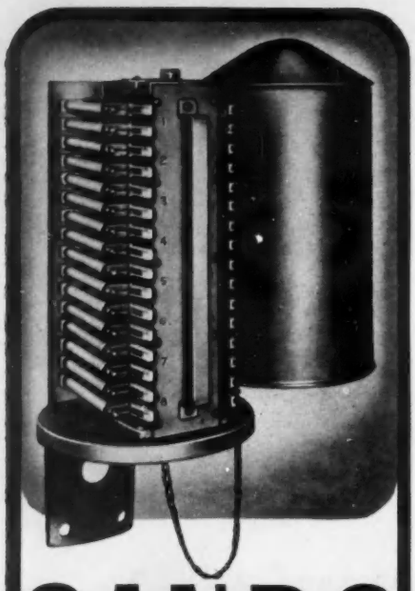
Dismantled telephone plant. Cedar and creosote poles, wire, telephone, Western and American Electric switchboard—magneto. Address James Brady, Hamilton, Ga.



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TYPE 35 PROTECTED CABLE TERMINAL

For 11, 16, and 26 Pair Cables

Name the features that telephone men want most in a protected terminal. You'll get them all in a Type 35—including the SANDS self grounding and automatic resetting discharge block.

This block (Sands Type 2105) is standard on all SANDS protective equipment. With it, protection lapses are banished, maintenance costs are cut.

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AUTOMATIC ELECTRIC

TELEPHONE SIGNALING AND COMMUNICATION APPARATUS

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Of Top Quality by **UNIQUE**

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- BLOW TORCHES
- WIPING CLOTHS
- BALANCED LADLES
- SOLDER IRON HANDLES
- THAWING TORCHES
- FOLDING SAFETY SHIELDS

Protect Public, Splicer, and Furnace. No. 50 C Shield shown here. Of 22 Ga. galvanized steel. Reinforced edges. 23"x17" x17". No. 50—four-sided with grate. No. 50 A—same without grate.

Your Jobber Has These Tools

UNIQUE MANUFACTURING CO., INC.

221 W. Walton St. — Chicago, Ill.

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IT'S GOOD BUSINESS to buy QUALITY

ACORN'S exclusive Carton packaging preserves carefully developed QUALITY until installed.

IN these days as never before it is wise to buy the best, whether its Drop Wire or clothing . . . providing of course, you can get SUPERIOR QUALITY without paying a premium for it. ACORN wire is available to you at a fair price. Write us today for complete details.

Parallel or Twisted
—Copper—Bronze—Copperweld

Inventory is no problem on ACORN wire due to orderly stacking and plain marking—No searching for hard-to-read, soiled or missing tags.

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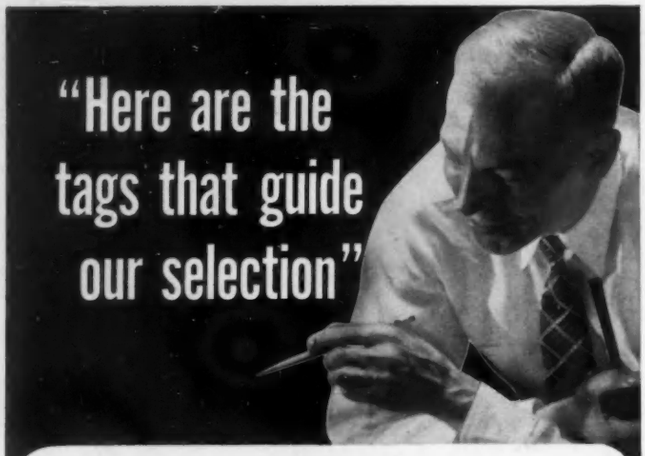

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. . . you can depend on these wires under all conditions

Amertel Telephone Wires and Amerstrand Steel Strand are made to withstand the shock of the most severe conditions. Rigid tests throughout manufacturing stages insure efficiency and toughness. A specially selected steel is used in the making of these wires—adequate corrosion-resisting features are actually built into them from the beginning.

These wires are evenly and heavily coated with the highest grade zinc obtainable—applied by the "hot dip" process, which assures a uniform chemical bonding of the zinc and steel. The complete, controlled union of the two metals prevents flaking of the galvanized coat and eliminates the possibility of a weak point of contact.

Amertel is available in the high tensile grades—85 and 135—as well as in the regular grades "EBB," "BB" and "Steel". Amerstrand is available in all standard grades and sizes. Write for complete technical information.

USS Amertel TELEPHONE AND TELEGRAPH WIRE AMERICAN STEEL & WIRE COMPANY

Amerstrand STEEL STRAND MADE BY AMERICAN STEEL & WIRE COMPANY

LOOK FOR THESE TAGS. *They are placed for your protection on every coil of Amertel Telephone and Telegraph Wire and Amerstrand Steel Strand.*

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

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Confidence In The *Specialist* Is Universal

In medicine and in law you go to a specialist when you want to be sure, because you know that the man who spends his life work on one thing can do that thing better than the man who generalizes.

Model 33

The same thing is true of manufacturers.

For 49 years we have designed and manufactured only instruments for accurate timing. Although we have often been tempted to turn to other lines, we have stuck steadfastly to our specialized line.

Isn't it natural that this concentration should result in producing better, more reliable, more durable toll timing instruments?

Model No. 6

There are three models of the Calculagraph that give an immediate, permanent and accurate record of every toll message.

Write for information.

THE CALCULAGRAPH COMPANY
308 Sussex St. Harrison, N. J.

CALCULAGRAPH
Accurate Toll Timing to the Second!

TYPIFY THE COMPLETENESS OF LEICH'S LINE OF MATERIALS

Telephone men recognize "Klein" pliers, "Atkins" saws, "V&B" hammers and "American Beauty" soldering irons as specification tools of proven quality. They are representative of Leich's complete line of materials for enduring telephone construction. It is important to remember that if it is a quality telephone product it is available from Leich. It is more important to remember that if it is available from Leich, it is a QUALITY PRODUCT.

Leich Service includes Switchboards, Telephones, P.B.X.'s, Ringing Machines, Protection Apparatus, and A Complete Line of Construction Materials, Tools and Supplies.

LEICH SERVICE

LEICH SALES CORPORATION

427 WEST RANDOLPH STREET • CHICAGO, ILLINOIS

FUNNY

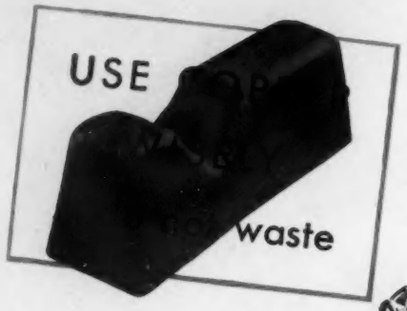
NY ITTLE THING — ISN'T IT?

MILLIONS and millions of these jolly bulbs—gayly colored, delicate little things—will be hanging in American homes again this year. For, where these gaudy little trinkets hang . . . there is happiness and plenty, contentment and thanksgiving.

Almost valueless though they may be, they play a part in celebrating a festive and holy occasion. They symbolize the security, the freedom and the hope of the American family.

So hang the holly, light the tree, fill the stockings! Prepare . . . for Saint Nick! He'll be here . . . for this is America, and it's Christmas, 1941.

KELLOGG SWITCHBOARD AND SUPPLY COMPANY



. . "*right!* WE are helping to Conserve Copper with Copperweld Line Wire and Copperweld Drop Wire"

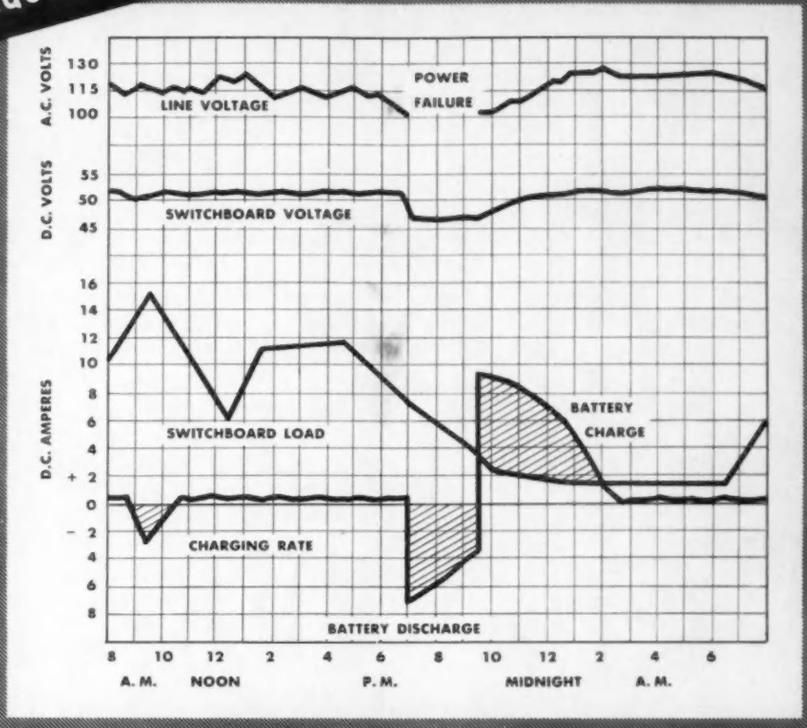
COPPER-BRONZE
Copper Line Wire requires 100% copper. Bronze drop wire requires almost 100% copper.
COPPERWELD
Copperweld Line Wire requires only 30 or 40% copper. Copperweld Drop Wire requires only 30 or 40% copper.

Today, when defense needs require COPPER and MORE COPPER, many telephone companies are specifying copper-saving Copperweld for line wire and drop wire. The steel core of Copperweld wire provides mechanical strength—the copper doing the job that copper does best—conducting electricity.

And the strength of the tough steel core in Copperweld is not reduced by rusting because of the thick protecting layer of pure copper. All Copperweld wire is guaranteed to have the rust-resisting life of solid copper. Copperweld wire stays new — its better voice transmission and greater safety are *permanent* characteristics.

Entered as Second Class Matter at the Post Office at Pontiac, Ill., under the Act of March 3, 1879.

RAYTHEON RECTICHARGER MEETS EVERY REQUIREMENT FOR TELEPHONE DC POWER



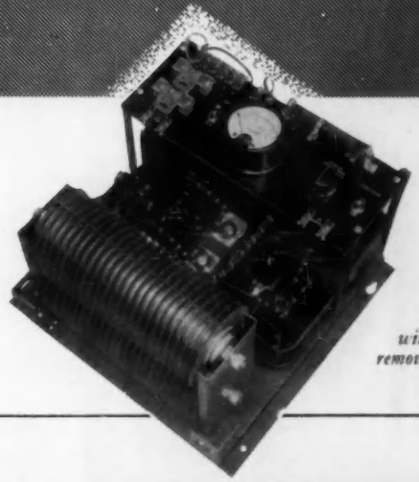
Everyone wants Constant Potential Charging because it insures the best possible telephone operation and because it charges the storage batteries under conditions favorable to maximum life.

The chart shows how the Raytheon RectiChargeR meets every telephone requirement for Constant Potential DC under all operating conditions.

1. NO LOAD
2. VARIABLE LOAD
3. OVERLOAD
4. VARYING AC LINE VOLTAGE
5. AC INTERRUPTION

All of this is accomplished without moving parts and makes the RectiChargeR ideal for unattended operation.

We will be very glad to send you further information or answer any specific questions that you may want to ask.



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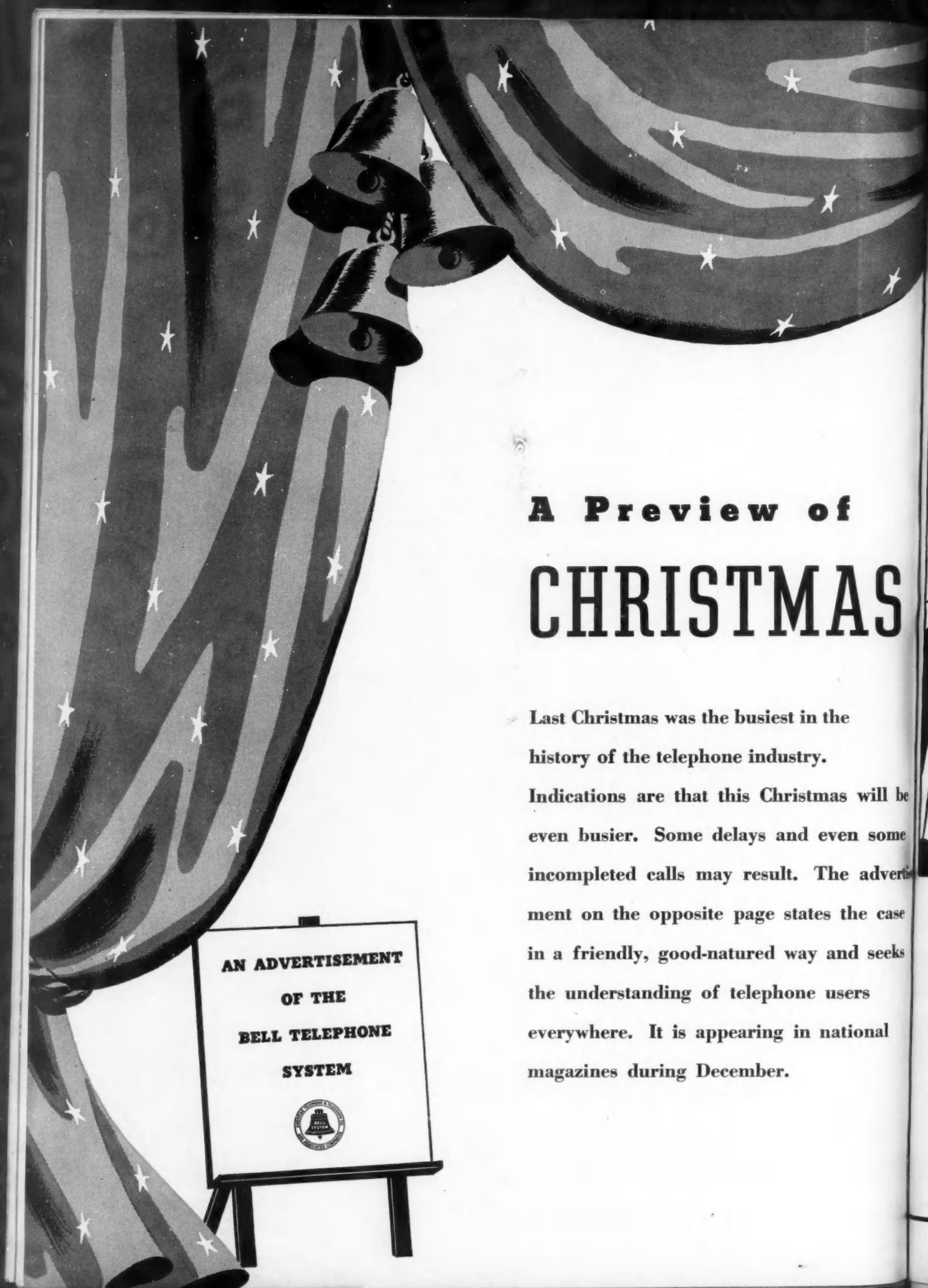
Manufacturing Company

134 Willow Street, Waltham, Massachusetts, U.S.A.



A Preview of CHRISTMAS

Last Christmas was the busiest in the history of the telephone industry. Indications are that this Christmas will be even busier. Some delays and even some incompleted calls may result. The advertisement on the opposite page states the case in a friendly, good-natured way and seeks the understanding of telephone users everywhere. It is appearing in national magazines during December.

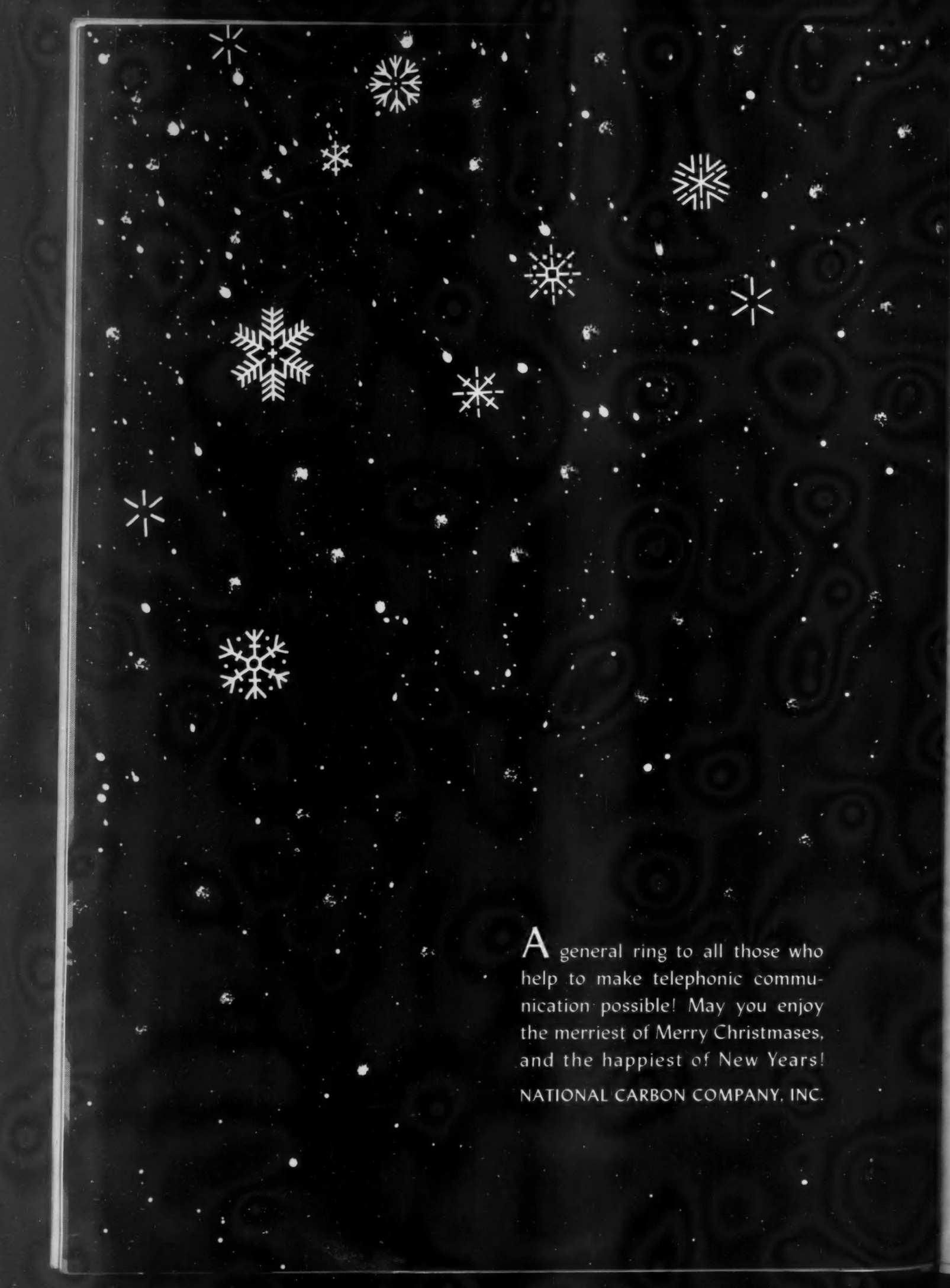
That's the situation your telephone company faces every Christmas. That's why there may be delays on some Long Distance Christmas calls.

• Last Christmas Eve and Day the wires were jammed. The switchboards were manned by regular and extra operators working all through the holiday. Long Distance telephone calls were three, five and at some places *eight* times normal.

We're glad so many folks want to exchange friendly greetings across the miles at Christmas — but sorry that, because of it, we can't supply service as good as usual.

We expect the biggest rush of calls we've ever had this coming Christmas. We'll do our best to prepare for it. But some calls will be slow. Some may not be completed. For these, we ask your patience and understanding. . . . *Thank you, and Merry Christmas!*

BELL TELEPHONE SYSTEM



A general ring to all those who help to make telephonic communication possible! May you enjoy the merriest of Merry Christmases, and the happiest of New Years!

NATIONAL CARBON COMPANY, INC.

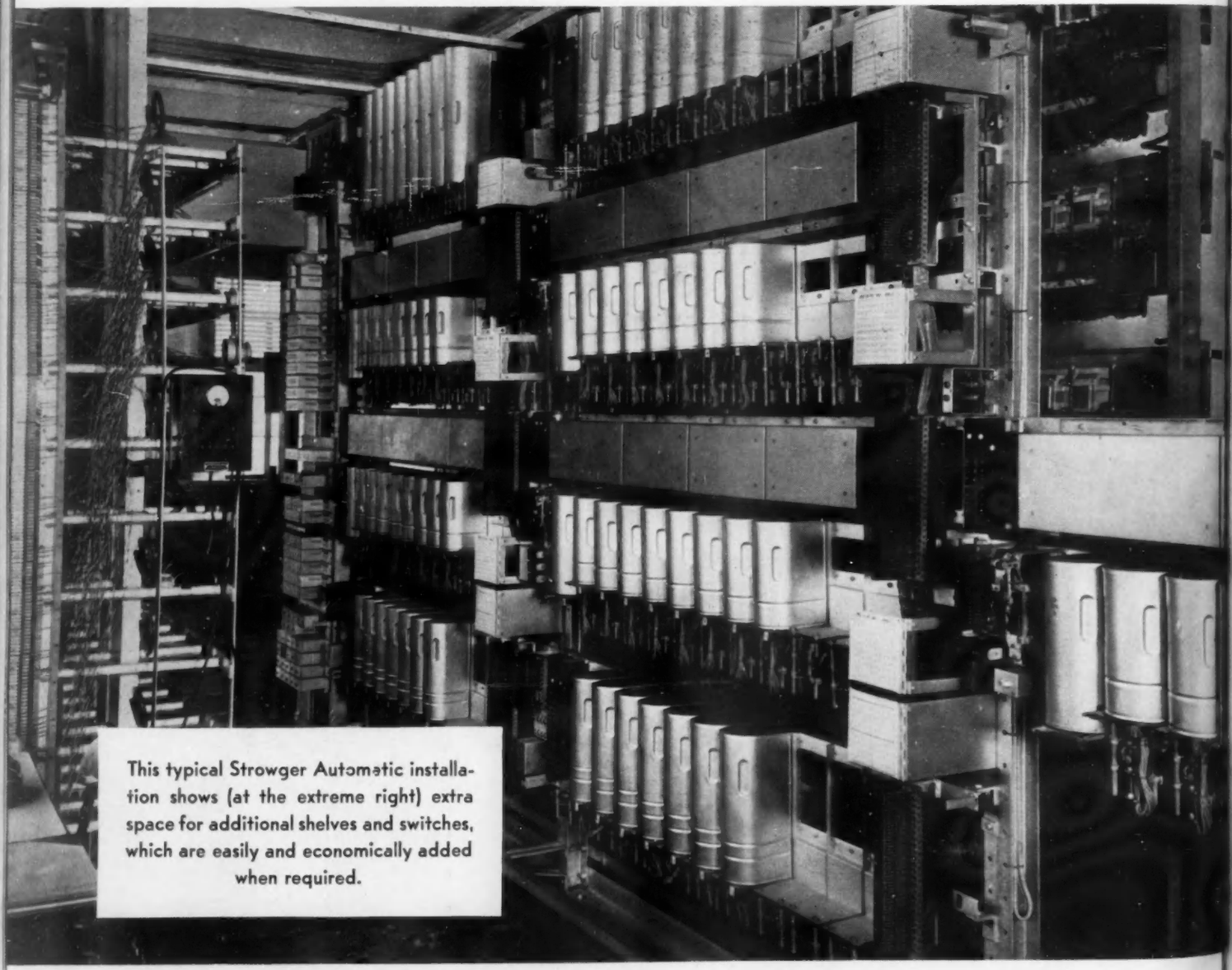
Uniflex is Compact

Uniflex is a new word for new economy, new flexibility, new efficiency in cable terminal construction, installation and service. Equally important is the revolutionary compactness of the Uniflex Cable Terminal permitting vertical or horizontal, single or tandem arrangements which mean great new savings in space, time and labor. Uniflex Cable Terminals are sold by all telephone equipment manufacturers and supply houses.

COOK ELECTRIC COMPANY
2700 SOUTHPORT AVENUE • CHICAGO

There's

plan fo



This typical Strowger Automatic installation shows (at the extreme right) extra space for additional shelves and switches, which are easily and economically added when required.

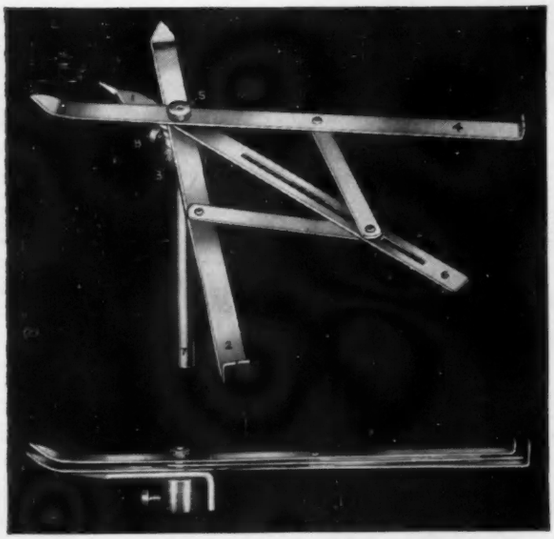
May the HAPPINESS and GOOD CHEER of the HOLIDAY SEASON Park at Your Door *Permanently*

Forty Christmas Days have been celebrated since "National" started business.

And now as we enter the holiday season once again, we do so with a feeling of thankfulness to our many friends, whose confidence in us—whose loyalty to us —and whose good will toward us has made possible our continued success.

All here at "National" trust that this year has brought you success and that your 1941 Christmas season will be filled with happiness and good cheer.

THE NATIONAL TELEPHONE SUPPLY COMPANY
CLEVELAND, OHIO



DILLON BISECTOR

DON'T TAKE CHANCES!

Improperly Guyed Corners and Curves Are Weak Links In ANY Lead. Make SURE the Angle Is Right with a

DILLON BISECTOR

It's Easy to locate exact position for anchors with this handy tool. Simply aim pointers at poles on opposite sides of pole to be guyed, and tail piece automatically indicates correct spot for anchor. Saves surveying time—equally as accurate.

Stop costly breakdown expenses by using the Dillon Bisector on every construction job. No complicated instructions to follow, any member of crew can use it. Equipped with spike tip for driving into pole, or may be placed right on surveying rod. With the Dillon Bisector, ***right*** anchor position can be found in ***less than 60 seconds!*** Decide ***today*** to equip your crews with this money saving, time saving anchor spotter!

ONLY **$4.00** F. O. B. CHICAGO

PROMPT DELIVERY ON ALL ORDERS FROM STOCK

W. C. DILLON & CO., INC.

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CHICAGO, ILLINOIS

Priorities and patience • • •

• While our Nation's endless production lines are turning out the goods to "keep 'em flying," the telephone industry maintains uninterrupted its lines of communication — a vital factor in National defense.

North's contribution consists in furnishing, among other things, "All-Relay" Dial Systems, and in maintaining their already established quality and reliability. If in this endeavor civilian orders are at times set aside to expedite defense deliveries, your patient cooperation in the future as in the past will materially aid in our Nation's great task. The NORTH ELECTRIC MFG. COMPANY, Galion, Ohio, U. S. A.

NORTH "ALL-RELAY"

DIAL AUTOMATIC EQUIPMENT•